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BIRD-BANDING

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THE MIGRATORY MOVEMENTS OF CERTAIN COLONIES OF HERRING GULLS (*LARUS ARGENTATUS SMITHSONIANUS* COUES) IN EASTERN NORTH AMERICA

By RICHARD JEFFERSON EATON

Introduction

UNTIL the last ten or fifteen years the migratory habits of Herring Gulls have been but little understood. Beyond the obvious facts of seasonal occurrence, arrival and departure dates, and normal limits of range of immature and adult birds, ordinary field observation has failed to contribute much knowledge. As recently as 1921 C. W. Townsend wrote:[1] "As the herring gull is found in summer as well as in winter to the south of the breeding range, it is difficult to set exact limits in time for the migrations;" and again, "The usual explanation given for the occurrence of the herring gull in summer south of its breeding grounds is that these birds are immature or, if adults, barren individuals."

As a result of extensive banding operations in recent years among many breeding gull colonies from the Great Lakes eastward, we shall soon be in a position to work out the details of their migratory traits with a high degree of accuracy. At the present writing it is highly probable, if not certain, that individual colonies (or groups of colonies) exhibit marked migratory peculiarities not shown by others, particularly in respect to the movements of first- and second-year birds. In general, immature gulls of the season make the longer flight to their winter territory, and those of the second year a much shorter one. It is believed that adults show little or no systematic migratory tendency except in the case of those colonies whose range is icebound in the winter. Recoveries from third- and fourth-year birds are not yet numerous enough to justify a confident statement of their habits. It is hoped that future

[1] A. C. Bent: *Life Hist. N.A. Gulls and Terns.* U. S. Nat. Mus. Bull. 113, 1921, p. 117.

banding work will determine the age at which Herring Gulls reach sexual maturity and answer the question implied by Townsend whether the adults occurring beyond the limits of their breeding range are sexually mature though unmated birds, or are in reality immature birds in quasi-adult plumage.

Systematic banding work among the newly established and rapidly growing rookeries in Essex County, Massachusetts, has already yielded enough data to throw new light on these questions and to indicate wholly unsuspected traits. The first part of the present paper records the results of five years' work among fledglings on certain islands near Beverly. A somewhat novel method of graphic analysis is presented, with the hope that other students will adopt it for making similar studies of their own chosen colonies. In the second part the idiosyncrasies of other gull colonies will be discussed briefly in order to emphasize certain characteristic peculiarities and to justify the highly speculative hypothesis to be proposed in the third, or concluding, part.

The salient features of this paper were communicated informally to the Nuttall Ornithological Club in February, 1932, but have been withheld deliberately from publication in order to secure more data. It is freely admitted that the conclusions here set forth are at best tentative and subject to modification in the light of future knowledge. If the writer succeeds in stimulating others to adopt the analytical methods herein proposed, and to extend their work to all the known colonies of Herring Gulls in North America, he is quite content to lay himself open to the charge of superficiality.

Before passing on to the main discussion, a brief review of the status of Herring Gulls along our Southern coast is given. Most authors of regional reports and local lists make little or no attempt to differentiate between immature and adult gulls. As an exception, Howell in "Florida Bird Life" (1932) affirms that the species occurs in Florida nearly throughout the year, being absent only during the summer months, although "non-breeding birds (chiefly immature) remain into the summer." According to Mr. Ludlow Griscom, the occurrence of adults at any season of the year along the Gulf Coast from the Mississippi southwestward is rare or casual, with their summer status gradually changing to uncommon northward, coastwise, as far as New Jersey. Mr. F. M. Weston writes that mature birds are common winter residents along the outer beaches near Pensacola, but "that all of my true summer observations have been immature birds."[2] Mr. Alexander Sprunt, Jr., states that the Herring Gull on the South Carolina coast is

without doubt the most abundant of their winter gulls, with adults occurring perhaps a little less frequently than the immatures.[3] He also reports that they are quite common from the Carolina coasts south at least as far as Miami (lat. 25° 40′).

In general the southwestern limit of normal winter range for adults would appear to lie between the mouth of the Mississippi and the west coast of Florida, and for immatures certainly as far southward as the mouth of the Rio Grande; whereas the southern limit of normal summer range of immature birds appears definitely to be north of Florida and probably north of Hatteras. As for adults in summer, it would seem to be abnormal for any considerable numbers to occur south of the limit of their breeding range in the Buzzards Bay region in southern Massachusetts. However, there are so many non-breeding birds in adult plumage in Long Island waters that New Jersey must be assigned as their normal summer limit. In any event, it is unwise to be didactic on the subject, if for no other reason than the surprising southward extension of breeding range of gulls during the past ten or fifteen years. Even the conservative Black-back (*Larus marinus*) has become a regular nesting bird on the New England coast as far south as Essex County, Massachusetts, during the last three or four years.[4]

PART I

The Essex County Colony

Description and Scope of Work

The discovery in 1928 of breeding Herring Gulls on certain rocky islands near the coast in Essex County, Massachusetts, has been previously recorded.[5] As a result of the enthusiastic coöperation of Mr. William Gordon Means, whose work and boat were equally indispensable, systematic banding operations at these islands have been conducted annually since 1929. Thanks are due Messrs. A. G. Means, E. F. Williams, C. E. Moulton, and L. B. Fletcher, and Dr. J. B. May for assisting in the work on one or more occasions.

It is not known exactly when the gulls started to breed on these islands, but the writer has reason to suspect that they

[2] Francis M. Weston *in litt.*, Aug. 14, 1933.
[3] Alexander Sprunt, Jr., *in litt.*, Aug. 7, 1933.
[4] See *The Auk* XLVIII: 588, Oct., 1931.
[5] *The Auk*, XLVIII: 588, Oct., 1931. *Bull. Essex County Ornithological Club*, 1931, p. 4.

first occupied Egg Rock, Manchester, as the pioneer rookery in 1926, or perhaps a year or two earlier. A rapid increase in the number of breeding pairs has occurred. In 1928 twenty nests were observed on Egg Rock; in 1929, over one hundred; subsequently the count has varied approximately from one hundred to one hundred and twenty nests. In 1929 one hundred juvenile birds were banded with difficulty on North Gooseberry Island, but the colony on South Gooseberry was considered too small to bother with. In 1931 one hundred juveniles were banded on North Gooseberry, and two hundred on South Gooseberry. This year forty birds were banded by Mr. Means on Eagle Island, a large rock about one mile southwest of the Gooseberries. This rock was not occupied in 1928 when the writer made a thorough survey of all the Essex County islands. It is probable that a few pairs bred there for the first time in 1932.

For the purposes of the present discussion no attempt will be made to differentiate the residents of the various islands into separate colonies. The overcrowding of the original site (Egg Rock) and the consequent occupation of adjacent islands is a good explanation for considering the group as a single colony, derived in all probability from the overcrowded stations along the Maine coast. A future study of the migration habits of numerous other North American colonies may throw some light on this question.

At the present writing, breeding Herring Gulls are confined to four small rocks or islands lying from one to three miles off shore and contained in a strip of water not over five miles long. No adult gulls have been banded. Our operations have been strictly confined to juveniles of the season. The earliest date of banding was June 21st and the latest, July 9th. An extreme irregularity of hatching dates has been noted each season, with juvenile gulls of all sizes in constant evidence.

Recoveries.

Excluding the banding done in the summer of 1933, the summary of our work is as follows:

Year	*Station*	*No. of Juvenile Gulls Banded*	*No. of Recoveries as of July 5, 1933*
1928	Egg Rock, Manchester	5	none
1929	" " "	100	3
1929	North Gooseberry Id., Salem	100	5
1930	" " " "	100	6
1930	South Gooseberry Id., Salem	100	8
1930	Egg Rock, Manchester	100	6

1931	North Gooseberry Id., Salem	99	4
1931	South Gooseberry Id., Salem	200	8
1932	Egg Rock, Manchester	44	3
1932	North Gooseberry Id., Salem	100	8
1932	South Gooseberry Id., Salem	100	4
		1048	55

Out of a total number of 1,048 banded birds, 55 recoveries have been reported by the Bureau of the Biological Survey. Without comparative data at hand, such a high percentage (5 per cent) is surprising and must indicate a very heavy mortality particularly among juvenile and immature gulls. The following detailed tabulation of recoveries shows that 10 out of the 55 recoveries (18.2 per cent) were juveniles less than two months old and found within five miles of the banding stations. An additional 34 (61.8 per cent) were less than one year old. The balance of 11 (20 per cent) were over one year old, and one was in its third year and two in their fourth year.

Analysis of Recoveries.

In order to visualize the results more readily, a map (Fig. 1) has been prepared showing the location of the place where each bird was recovered. Open circles represent first-year birds, black dots represent second-year birds, and small open circles all others. A large circle centering on Salem, Massachusetts, represents the banding stations and the ten local juveniles recovered within a radius of five miles, and other first-year immatures recovered in the region of eastern Massachusetts.

Perhaps the first point which this map emphasizes is the strictly coastal character of the migration. With the exception of an inland recovery in South Carolina and one in Louisiana, not a single bird has been reported from fresh water. Another striking fact is the relatively large number of recoveries of first-year immatures along the Gulf Coast from Louisiana to the Rio Grande. It is still doubtful whether the absence of any recoveries in Mexico is of any significance. Immature Herring Gulls have been frequently observed as far south as Vera Cruz, and the Essex County colony may migrate beyond the limits of Texas. A third interesting point is the entire absence of any recovery northeast of Ipswich. The evidence is conclusive that there is no significent northward drift of first-year birds prior to the fall migration. It is also possible that mature gulls hatched in Essex County return to southern New England waters and remain there for the rest of their lives.

DETAILED RECORD OF RECOVERIES FROM THE ESSEX COUNTY COLONY

Banding Station Essex County, Mass.	*Date of Banding*	*Band No. of Recovery*	*Place of Recovery*	*Date of Recovery*	*Reference*[a]	*Age of Gull Recovered*
Egg Rock, Manchester	6/21/29	387254	Staten Id., N. Y.	10/ 2/29	I	1st year
		387251	Quantico, Va.	1/17/30	K	" "
		387214	Woods Hole, Mass.	3/31/30	FD	" "
North Gooseberry Id., Salem	6/29/29	A609054	Fernandina, Fla.	2/ 3/30	FD	" "
		A609016	Pleasant Bay, Orleans, Mass.	5/31/30	—	" "
		A609002	Nantasket Beach, Mass.	3/18/31	FD	2d year
		A609034	North Plymouth, Mass.	2/ 4/32	—	3d year
		A609086	Hingham, Mass.	12/30/32	—	4th year
South Gooseberry Id., Salem	6/21/30	A609268	Beverly, Mass.	8/ 4/30	FD	1st year (local)
		A609298	Eagle Id., Salem, Mass.	9/22/30	FD	" "
		A609217	Peach's Pt., Marblehead, Mass.	10/11/30	FD	" "
		A609209	Ocean City, Md.	11/11/30	—	" "
		A609300	St. Dennis Id., La.	12/ 5/30	C	" "
		A609297	Angel City, Fla.	12/15/30	C	" "
		A609212	Marsh Id., La.	1/21/31	C	" "
		A609291	South Chatham, Mass.	7/ 5/33	FD	4th "
North Gooseberry Id., Salem	6/21/30	A609442	Marblehead, Mass.	8/20/30	FD	1st year (local)
		A609411	30 miles west of Columbia, S. C.	11/22/30	FD	" "
		A609453	New Verde, La.	12/10/30	C	" "
		A609413	Seadrift, Texas	3/ 2/31	K	" "
		A609480	Port Bolivar, Texas	3/22/31	FD	" "
		A609434	Beach Haven, N. J.	1/ 1/32	—	2d "
Egg Rock, Manchester	7/ 2/30	A609102	Manchester, Mass.	7/20/30	FD	1st year (local)
		A609138	Beach Haven, N. J.	10/14/30	FD	" "
		A609196	Berwick, La.	11/10/30	C	" "
		A609189	Biloxi, Miss.	5/ 2/31	C	" "
		A609191	Marblehead, Mass.	10/ 5/31	—	2d "
		A609107	Magnolia, Mass.	5/24/32	FD	" "
North Gooseberry Id., Salem	7/ 7/31	A695002	Eagle Id., Salem, Mass.	8/10/31	FD	1st year (local)
		A695048	Galveston, Texas	2/10/32	FD	" "
		A695006	Neponset, Mass.	11/28/32	I	2d "
		A695022	Nahant Beach, Mass.	3/28/33	—	" "
South Gooseberry Id., Salem	7/ 7/31	A695209	Banding Station	7/28/31	FD	1st year (local)
		A695291	" "	7/28/31	FD	" " "
		A695277	North Truro, Mass.	9/ 5/31	FD	" "
		A695279	Beverly Farms, Mass.	9/28/31	FD	" "
		A695170	Aransas Bay, Texas	1/ 2/32	FD	" "
		A695232	Aransas Pass, Texas	2/ 7/32	S	" "
		A695215	Beaufort, N. C.	11/25/32	C	2d "
		A695267	Seabright, N. J.	12/16/32	—	" "
Egg Rock, Manchester	7/ 3/32	A695431	Manchester, Mass.	7/ 7/32	FD	1st year (local)
		A695426	" "	7/16/32	FD	" " "
		A695421	Gloucester, Mass.	8/18/33	FD	" " "
South Gooseberry Id., Salem	7/ 9/32	A695327	Near Fairhaven, N. J.	10/13/32	FD	" "
		A695387	Velasco, Texas	1/ 5/33	FD	" "
		A695378	Galveston, Texas	3/ 4/33	FD	" "
		A695328	Bayville, L. I.	abt. 5/1/33	FD	" "
North Gooseberry Id., Salem	7/ 9/32	B674657	Beverly Farms, Mass.	8/ 9/32	FD	" " (local)
		B674610	Winthrop Beach, Mass.	8/29/32	FD	" "
		B674683	Salem, Mass.	9/21/32	FD	" "
		B674647	Hatteras, N. C.	9/28/32	FD	" "
		B674693	Camden, N. J.	11/ 8/32	—	" "
		B674685	Gloucester, Mass.	11/12/32	S	" "
		B674612	Port Aransas, Texas	3/12/33		" "
		B674693	Hillsboro Bay, Fla.	4/20/33		" "

[a] References: C—Caught, FD—Found dead, I—Injured, K—Killed, S—Shot

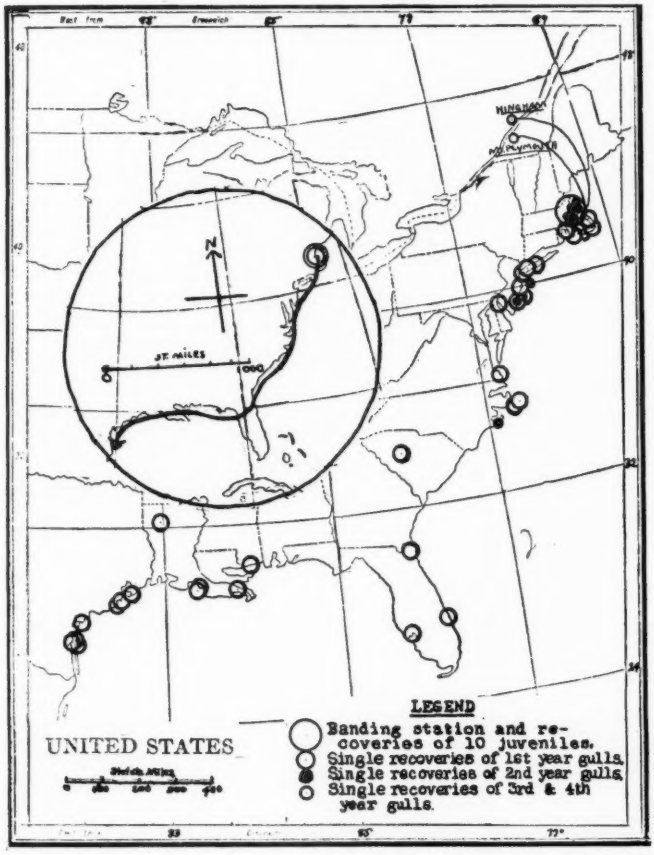

Figure 1. Map showing Recoveries from the Essex County Colonies of Herring Gulls. Insert: The "Migration Characteristic" of first-year birds from the same colonies.

The data are too limited to justify any generalization on this score. About all that can be said is that not a single recovery, even of the eleven second-year or older birds, has occurred north of Massachusetts. Another interesting point to consider is whether the main line of migration crosses the Florida Peninsula rather than follows the coast-line. A glance at the map suggests the possibility that the Essex County birds do not follow the coastline, but cross Florida at about the latitude of Tampa (lat. 28°). The common occurrence of immature gulls as far south as Miami has already been alluded to, but possibly they may prove referable to other colonies possessing other migratory traits.

Another fact of probable significance to be noted from this map is the complete absence of recoveries of second-year or older birds from places south of Hatteras (lat. 35°). The data for third-year and older birds are, of course, inconclusive, but it should be noticed that each of the three recoveries in this category occurred within forty miles of the banding station. Considering that mature gulls are reported common in winter as far south as Pensacola at least, it seems rather curious that all recoveries from the Essex County colony from North Carolina southward should be immature birds. Unless subsequent work shows the present data to have been misleading, we may accept as a working hypothesis that the adult gull population of the South Atlantic States is derived from other breeding colonies possessing different migratory traits. The plausibility of such an idea is strengthened by certain facts to be brought out in a subsequent installment of this paper.

In order to give due consideration to the time element in the Herring Gull migration, a graph (Fig. 2) has been constructed, using the age of the bird and the distance from banding station as the two salient coördinates. In Figure 2 the horizontal line, or abscissa, represents the time-scale, with each month of the year marked off and extending for three years. In order to economize space, the time-scale for second and subsequent years has been reduced by one half, and the recoveries of the third- and fourth-year birds are plotted in together. The fourth year recoveries are indicated by an open circle with an included cross. Nestlings are assumed to be hatched on July 1st and hence become one year old in the following June. The vertical line, or ordinate, represents distance in miles from the banding station to the place of recovery, that portion of the line above the abscissa representing distances to the northeast of the banding station and that portion below as south of the station. Air-line distances are computed along the coast

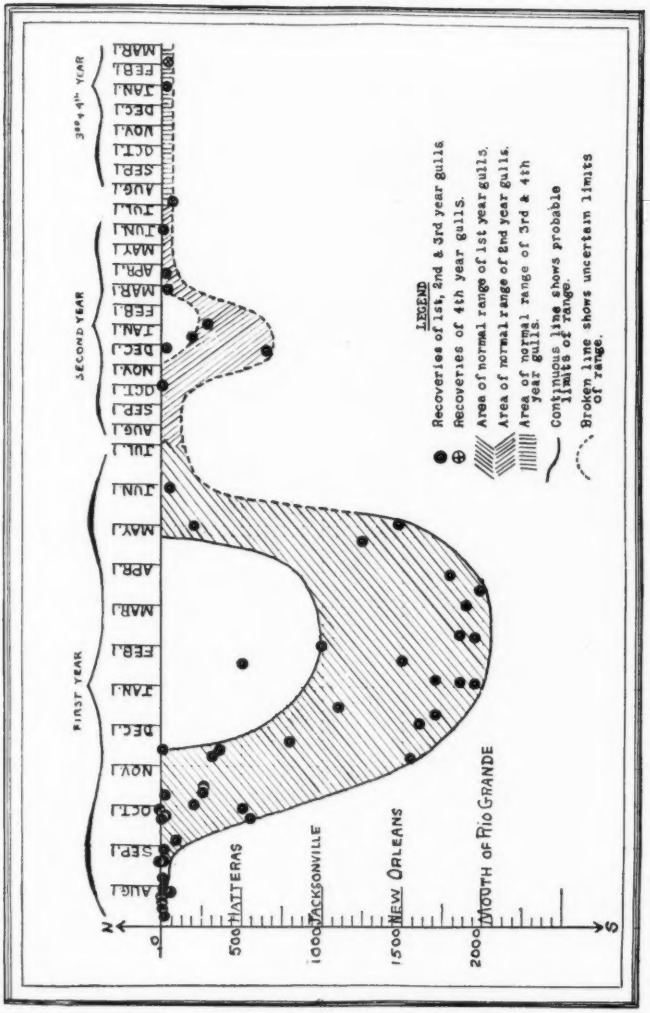

Figure 2. Graph of Recoveries from the Essex County Colonies of Herring Gulls.

to Hatteras, thence to Jacksonville, Florida, and thence to New Orleans. Thus a recovery in Delaware would be measured by a true air-line distance; a recovery in South Carolina by air-line to Hatteras and thence to the place of recovery, and so on.

By this means, a black dot on the graph indicates the age of a recovered bird in years, months, and days, as well as the distance from the banding station and, roughly, the direction. In order to indicate probable and hypothetical *normal* limits of range for the immature gulls up to and including their fourth year, the areas have been appropriately outlined and shaded. The margins of the shaded areas bounded by solid black lines may be accepted as *highly* probable, while those bounded by broken line as probable, uncertain, or hypothetical.

This graph is peculiarly illuminating as it suggests with unmistakable clearness a probable picture of the migrating habits of first-year birds from this particular colony of Herring Gulls. The juveniles of the season remain in the vicinity of the rookery for at least two and probably three months after hatching. The southward drift of the more precocious birds appears to begin early in September and is well under way by October 1st. Two recoveries are noted from the vicinity of Hatteras prior to this date. The vanguard reaches the Gulf Coast by November. A leisurely drift southwestward continues throughout November and December to an apparent centre of concentration between Galveston and the Rio Grande. If we may accept the seven recoveries in March, April, and May as valid evidence, there is a strong likelihood that the northward flight does not begin until early April. A recovery at Bayville, Long Island (200 miles south) "found dead about May 1st", and another at Pleasant Bay, Orleans, Massachusetts, "found dead on May 31st," strongly suggest the return of the migrants to the North Atlantic States early in May and to Massachusetts waters by June 1st.

Before proceeding to a discussion of the movements of second- and third-year immatures and adults, it is appropriate to mention certain points of interest in connection with this portion of the diagram. There are at least two and possibly three recoveries which are open to suspicion on the ground of being erratic. On November 12th, B674685 was found at Gloucester, Massachusetts, "sick and exhausted". We are justified in assuming that this bird was left behind, rather than accepting the date as normal for healthy stragglers. Thus, until evidence to the contrary is secured, we may assign mid-October as the period when the last birds of the season have left the cold waters of Massachusetts Bay. The

second abnormal recovery is 387251, "killed" at Quantico, Virginia, on January 17th. Lacking further information, we are uncertain whether the bird was a weakened laggard or whether Cape Hatteras represents the northern limit of normal winter range for first-year birds. It may well be that the former interpretation is correct, owing to the fact that only one recovery has been reported from a station north of Jacksonville, Florida, between November 15th and May 1st. Owing to the relative density of midwinter recoveries near Galveston, Texas, it seems logical to assume that the normal midwinter range of first-year birds from this colony centers near that point, and to assign the northern coasts of Florida as the normal northerly limit. The third suspicious recovery is A609189, "found" at Biloxi, Mississippi, on May 2d. In view of the Long Island recovery on May 1st, it seems likely that the Biloxi bird has been accidentally delayed, perhaps by weakness or injury. Once again, until more evidence is accumulated, we shall tentatively reject the significance of this recovery.

In this connection it is well to bear in mind the obvious fact that the reported date of recovery may not coincide closely with the date of death. Hence, the line, or curve, of early recoveries representing the vanguard of the migration is far more significant than the curve of the stragglers which may have been delayed by injury or found weeks after death. Hence, at this early stage in the investigation we must consider any generalizations as merely probable deductions drawn from incomplete evidence.

The migration curve of immature second-year birds as represented by eight recoveries is strikingly different. Between July 1st and November 1st a single recovery has been reported, but none south of Massachusetts. On October 5th a bird was found at Marblehead (about six miles from Egg Rock, where it was hatched). The latest fall date for a Massachusetts recovery is November 28th at Neponset. This bird had a broken wing and was badly emaciated. As a normal "late date" it is of little significance. Between November 28th and March 18th no recovery has been reported north of Seabright, New Jersey. The southerly limit of the second-year migration appears at this writing to be Beaufort, North Carolina, (A695215 on November 25th).

Although a dogmatic statement based on eight recoveries must be avoided, the writer does not hesitate to accept the implications of this portion of the diagram as probable. In general, it may well turn out that immature second-year birds

from the Essex County colony habitually depart from the Boston region sometime between October 1st and December 1st to their winter resorts along the Atlantic Coast between New Jersey and Florida, and return to the vicinity of their birthplace in March and April. On the mathematical law of chances, we are justified in assigning Hatteras as their centre of winter dispersal and in asserting that the Gulf Coast is probably beyond their normal limit of range.[7] We may well consider that the second-year birds have acquired a degree of hardihood which obviates the necessity of their wintering in the semitropical waters of the Gulf.

Of the movements of third- and fourth-year birds, we must withhold judgment. The only third-year recovery (A609034) at North Plymouth, Massachusetts, February 4th is in midwinter. The two fourth-year recoveries (A609086 at Hingham, Massachusetts, December 30th, and A609291 at South Chatham, Massachusetts, July 5th) show midwinter and midsummer records, each within eighty miles of the banding stations. At best, these records suggest that no important southern migration occurs among gulls from this colony after the second year.

In summary, it may be stated that gulls of the season from the Essex County colony normally winter along the Gulf Coast with the centre of concentration near Galveston (average date of arrival about December 1st, average date of departure about April 1st), and return to Massachusetts for the second summer (estimated average date of arrival May 15th). It is probable that the second-year gulls winter along the Atlantic Coast from New Jersey to Florida, with a centre of dispersal at Cape Hatteras (estimated average dates: departure from Massachusetts October 15 (?), arrival at winter territory November 1 (?), spring departure—no evidence. It is a reasonably intelligent guess that third-year and adult gulls do not migrate in the usual sense of the word.

(*To be continued*)

[7] It is conceivable that the eight recoveries might fall into a pattern which in no way resembles the true normal pattern of distribution, but it is very unlikely. If we mark *at random*, by some mechanical method that eliminates the possibility of deliberate selection, eight shot-holes on the pattern from a shotgun, the chances are that our marks will give us a pretty fair idea of the real pattern even if we are in entire ignorance of the location of the rest of the holes. If the locus of the marks is roughly circular in shape, we should be justified in thinking that the target was perpendicular to the trajectory. If the marks form a long and narrow pattern, we should assume quite rightly that the plane of the target was tilted away from perpendicularity. Thus, possessing only limited knowledge, we are permitted by the law of chances to deduce the *probable* truth.

STATE DISTRIBUTION OF RETURNS FROM BANDED DUCKS

Fifth Paper: Pennsylvania, Saskatchewan, South Carolina, Texas, Utah, and Wisconsin[1]

By FREDERICK C. LINCOLN

IN the present paper there is briefly discussed the data resulting from ducks banded in Pennsylvania, Saskatchewan, South Carolina, Texas, Utah, and Wisconsin. The purpose of the series (of which this is the last) is to acquaint students of birds, sportsmen, conservation officials, and others with the information relative to the movements of our migratory waterfowl that is being accumulated by the Biological Survey through the banding of large numbers of birds at various stations throughout the country. This is a thoroughly modern method for such investigations, and it is hoped that in these brief summaries this fact has been demonstrated to all those concerned with these birds, whether from the viewpoint of science, sport, or administration. In the opinion of the author the banding method is the "Court of Last Appeal" for the development of incontrovertible evidence that may be applied to many problems associated with our avifauna.

The maps presented show the banding point or points as a circumscribed area in which the number of local recoveries may be designated, or this figure may be placed close by at the end of a short line. Lines have been drawn from the circumscribed areas to the different States and Provinces where the banded birds have been retaken. These lines should not be interpreted as indicating flight lines or routes of migration. The numbers represent the total of return records for all species, although the status of each is usually given in the accompanying statement. The data used in these reports are as compiled on July 1, 1932, material accumulating since that time being omitted, to permit proper comparisons. These statements are much condensed because of the limited space available. Detailed technical reports relative to the distribution and migration of the different species are planned for future publication.

[1] First paper, *Bird-Banding*, Vol. 3, pp. 140–142, October, 1932.
Second paper, *Bird-Banding*, Vol. 4, pp. 19–32, January, 1933.
Third paper, *Bird-Banding*, Vol. 4, pp. 88–99, April, 1933.
Fourth paper, *Bird-Banding*, Vol. 4, pp. 132–146, July, 1933.

Figure 1. Distribution of Returns from Ducks Banded in Pennsylvania.

Return data from the following States and Provinces have been discussed in the preceding papers: Alberta (first paper); British Columbia, California, Connecticut, Georgia, Illinois, Iowa, and Kansas (second paper); Louisiana, Maine, Massachusetts, Michigan, Minnesota, and Missouri (third paper); and Montana, Nebraska, New Jersey, New York, North Dakota, Ontario, and Oregon (fourth paper).

PENNSYLVANIA

Waterfowl banding in Pennsylvania has been limited to the operations of Frank B. Foster, Montcalm Game Farms, near Phoenixville. The birds have been all hand-reared, produced from stock originally captured in Alberta. When advised that a large number of these birds were to be released full-winged, the Biological Survey gladly coöperated and furnished bands from the regular series, in the belief that the resulting data might have a far-reaching influence upon future restocking plans. Altogether 2,300 Mallards were banded, 800 in 1930, and 1,500 more in 1931. From these birds 29 returns have been received. The small percentage of recoveries is most significant, since from this number of wild-caught Mallards the normal first-year expectancy would be at least 230 returns, which during four or five years next ensuing should increase to between five and six hundred. The indication is that either these hand-reared birds failed to migrate or that they were unable to care for themselves and soon succumbed from causes other than shooting. With this situation in mind it is of interest to examine the map (Fig. 1).

It will be noted that an area with a radius of 100 miles has accounted for 21 of the 29 records and that none of these ducks have been recovered south of Chesapeake Bay, indicating almost complete localization in the general region of liberation. On the other hand consideration must be given to the few birds that obviously did associate themselves with wild flocks and migrate to northern breeding grounds. It is particularly noteworthy that some of these succeeded in reaching the great interior breeding grounds as is shown by the single records from Michigan,[2] Minnesota, Iowa and Kansas.

SASKATCHEWAN

The total number of ducks that have been banded in Saskatchewan is about 700. The work was begun in 1923 at Muscow, by Richard H. Carter, Sr., and his sons Richard H., Jr., and John R.; and at Davidson, by Reuben and Bert Lloyd. The operations at these stations have been continued each season. Starting in 1926 and continuing during several seasons since, J. A. M. Patrick has banded several ducks in the general vicinity of Yorkton. Of the total number banded in this Province, Mallards constitute nearly 500, the others including

[2] Through an error on the original map a line to Michigan was omitted, and this was not detected until after the cut had been made.—F. C. L.

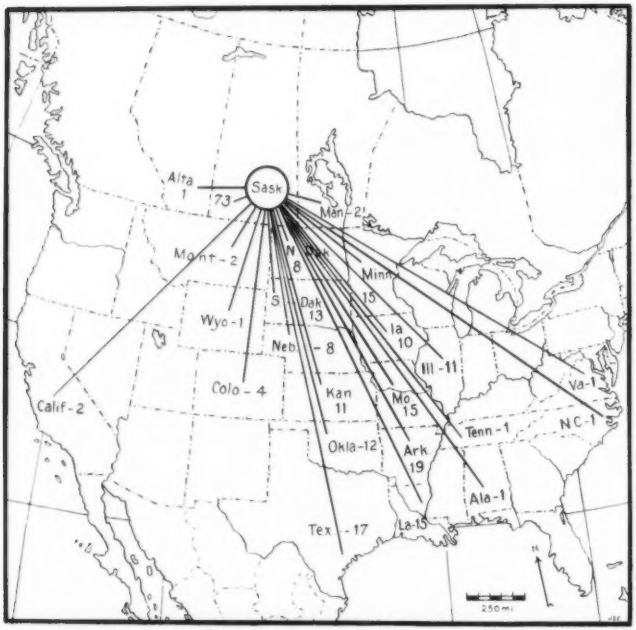

Figure 2. Distribution of Returns from Ducks Banded in Saskatchewan.

about 50 Pintails, and a few each of the Canvasback, Redhead, Lesser Scaup, Shoveller, Gadwall, Green-winged Teal, and Blue-winged Teal. Some of the Mallards banded at Muscow have been hand-reared birds and in some instances they have been hybrids between native stock and the so-called English call duck. From these activities 243 return records are available for study, the return ratio being unusually high.

The southward migration is clearly shown across the Plains States southeastward to the Mississippi Valley (Fig. 2), with most of the ducks finding winter quarters in the lower Mississippi Valley, and in Texas. It is noteworthy that while there are 15 records from Minnesota there are none from Wisconsin, indicating that the eastern boundary of the main flight is very

sharply defined. The only State east of the Mississippi River reporting more than one return record is Illinois, where the valley of the Illinois River causes a short eastern curve in the flight, which, however, swings back to the west as or before it leaves that State. The Atlantic Coast records were made by a Lesser Scaup that was recovered in Virginia, and by a Widgeon that was killed in North Carolina. Both of the California records are for Pintails.

Attention also should be directed to the small number of birds banded in Saskatchewan that have been recaptured in neighboring Provinces even in succeeding seasons, which suggests that the majority of the birds return to breed in the region where they were banded.

SOUTH CAROLINA

Extensive banding of migratory waterfowl in South Carolina was begun by Clarence E. Chapman, owner of Mulberry Plantation, near Oakley, during the early spring of 1924, and since that time this station has been operated for a month or more practically every year. About 1,200 ducks have been banded, chiefly Ring-necks, Mallards, and Blue-winged Teals, but including also Black Ducks, Wood Ducks, Lesser Scaups, and a few Ruddy Ducks.

Dr. Henry Norris, owner of Litchfield Plantation, at Waverly Mills, banded 26 Ring-necks and Black Ducks during February, 1928.

In February, 1930, E. Milby Burton, Director of the Charleston Museum, started banding operations with waterfowl, working chiefly in Colleton County. A total of 594 birds, mostly Lesser Scaups and Ring-necks, have been marked. In addition to the species named this total also includes 58 Pintails and a few Mallards, Black Ducks, Widgeons (one European), and Blue-winged Teal.

During December, 1931, and January, 1932, Dr. Oliver L. Austin, Jr., of the Biological Survey, operated a duck banding station at Bonneau Ferry Plantation, near Cordesville, banding 320 Ring-necks, 609 Scaups, both Greater and Lesser, 34 Wood Ducks, 7 Pintails, and 4 Widgeons. The total for the State is 2,783, from which 226 return records have been received as follows: Mallard, 46; Black Duck, 11; Pintail, 17; Blue-winged Teal, 72; Ring-neck, 32; Scaups, 48.

The heavy percentage of local records (Fig. 3) is due in part to retrapping, as Mr. Chapman has recaptured many of the ducks banded by him in previous seasons.

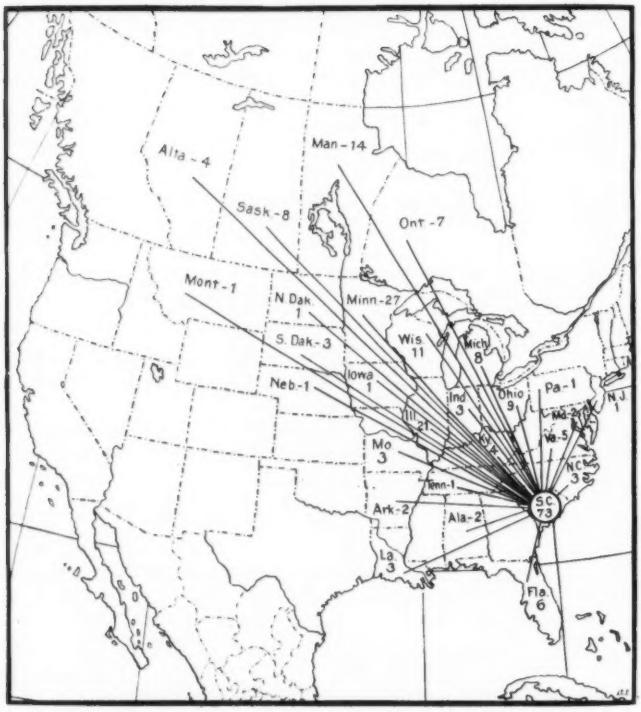

Figure 3. Distribution of Returns from Ducks Banded in South Carolina.

The flight lines indicated by the data are of unusual interest and they do much to confirm the route suggested under the treatment of the records from ducks banded in Georgia[3], namely that an important flyway crosses some of the southeastern States to and from the Mississippi Valley. On the basis of the numerical status of the returns from the different States and Provinces, it appears that the flight traverses a

[3] *Bird-Banding*, Vol. 4, p. 26.

wider area east of the Mississippi River than has been observed in the case of the birds from any other banding locality.

Breeding grounds are indicated in Michigan, Wisconsin, Minnesota, Ontario, and the Prairie Provinces of Canada. In the return of the birds to winter quarters it appears that the flight direction is principally southeast across these States and also through Illinois, Indiana, and Ohio. South of Minnesota it will be observed that only a few ducks were recovered west of the Mississippi River.

TEXAS

A waterfowl banding station was started in May, 1928, at the Tehuacana Lake Club, near Waco, by William P. Sparks. At that point 1,055 ducks have been banded. Of these the Pintail leads with 803, followed by the Green-winged Teal with 112, and the Blue-winged Teal with 43. Smaller numbers of Mallards, Widgeons, Lesser Scaups, Redheads, Gadwalls, and Shovellers, also have been banded.

More recently Mrs. Mary D. Woodson, also of Waco, has established a station. Her records are not, however, considered in the present study.

Return records to the number of 135 have been received from birds marked by Mr. Sparks, of which 104 are for the Pintail, 10 each are for the Mallard and the Lesser Scaup, while the balance is scattered between the Gadwall, Widgeon, Shoveller, and Green-winged and Blue-winged Teal. The map (Fig. 4) accordingly can be considered as an excellent illustration of the migration of those Pintails that winter chiefly in Texas. The route is obviously almost due north to the Canadian boundary where it turns northwestward, a few penetrating the north as far as Mackenzie and Alaska. With the exception of the six records from Illinois (one of which is for a Mallard) and the one (Green-winged Teal) from Alabama, it will be observed that all returns are from points west of the Mississippi River. In this vast area, however, there is a wide dispersal which is best evidenced by the fact that the single records from British Columbia, Montana, and Washington, the two returns from Nevada, and 16 of those from California, are for Pintails. The other record from California is for a Mallard (No. A655168), banded in February and recovered near San Francisco during the following November.

The great range of the Pintail also is well illustrated by the fact that all of the Texas banded ducks reported from Mexico have been of this species.

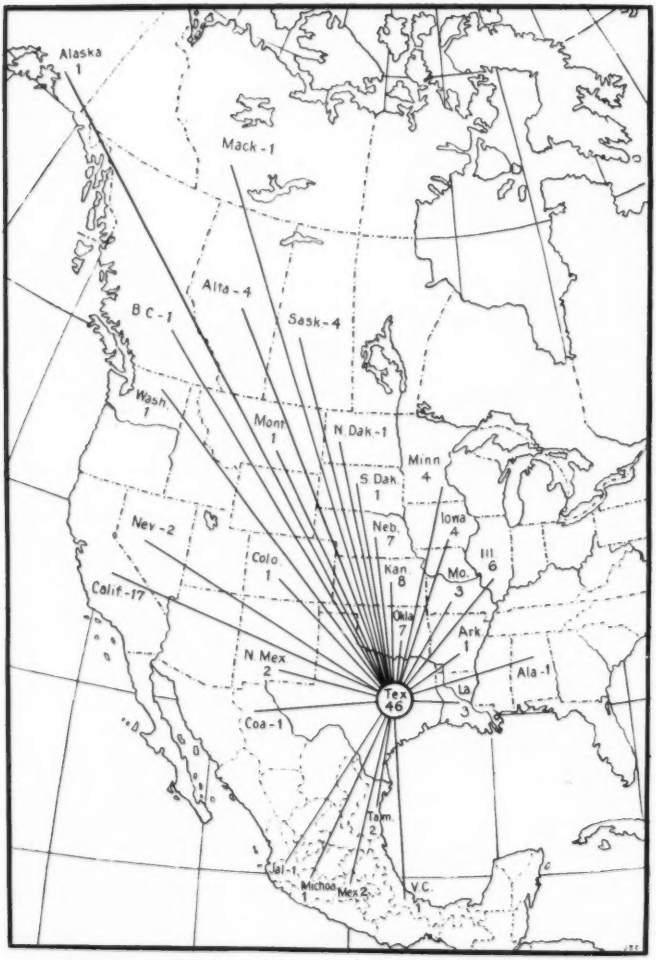

Figure 4. Distribution of Returns from Ducks Banded in Texas.

UTAH

The pioneer banding work of the Biological Survey was conducted by Dr. Alexander Wetmore in the Bear River Marshes at the north end of Great Salt Lake during the period from 1914 to 1916. Bands were placed on 994 ducks of nine species, most of them being Redheads, Green-winged Teals, and Pintails, but including also Mallards, Gadwalls, Cinnamon Teals, and Shovellers. The recovery records from these birds formed the subject of a special report by Doctor Wetmore.[4] For the sake of completeness they are included in the present study.

During the summer of 1926 the author visited these marshes and banded 881 ducks as follows: 375 Redheads, 182 Cinnamon Teals, 106 Pintails, 99 Mallards, 40 Green-winged Teals, 32 Shovellers, 30 Gadwalls, 13 Ruddy Ducks, and 4 Canada Geese.

The work resumed at that time has been continued chiefly by Archie V. Hull, of Brigham, under the direction of Mr. George E. Mushbach, Superintendent of the Bear River Migratory Bird Refuge. The number of ducks so added is 4,041, divided by species as follows: 2,327 Redheads, 1,063 Green-winged Teals, 412 Pintails, 102 Cinnamon Teals, 69 Shovellers, 51 Mallards, 31 Gadwalls, 8 Widgeons, 7 Ruddy Ducks, 1 Lesser Scaup, and 1 Bufflehead.

The total number of ducks banded in Utah by all parties, is 5,916, from which 824 return or recovery records have been received. Of these 471 are for the Redhead, 156 are for the Green-winged Teal, and 103 are for the Pintail.

The region about Great Salt Lake, particularly its eastern and northern shores is an area of intensive shooting, not only on open land and private clubs, but also on State-owned public shooting grounds. It is accordingly not surprising that there should be such a large percentage of local recoveries.

It should be particularly noted that only nine records are from points north of the Canadian border (Fig. 5). The reason is, of course, that most or all of the ducks banded in Utah were marked during the summer months or early autumn and were actually on their breeding grounds. Such being the case, the migration lines indicated by the return data are of unusual interest. In addition to the movement to the southwest into California and southeast across the mountains and

[4] Migration Records from Wild Ducks and Other Birds Banded in the Salt Lake Valley, Utah. U. S. Dept. Agri. Bull. 1145, May 10, 1923.

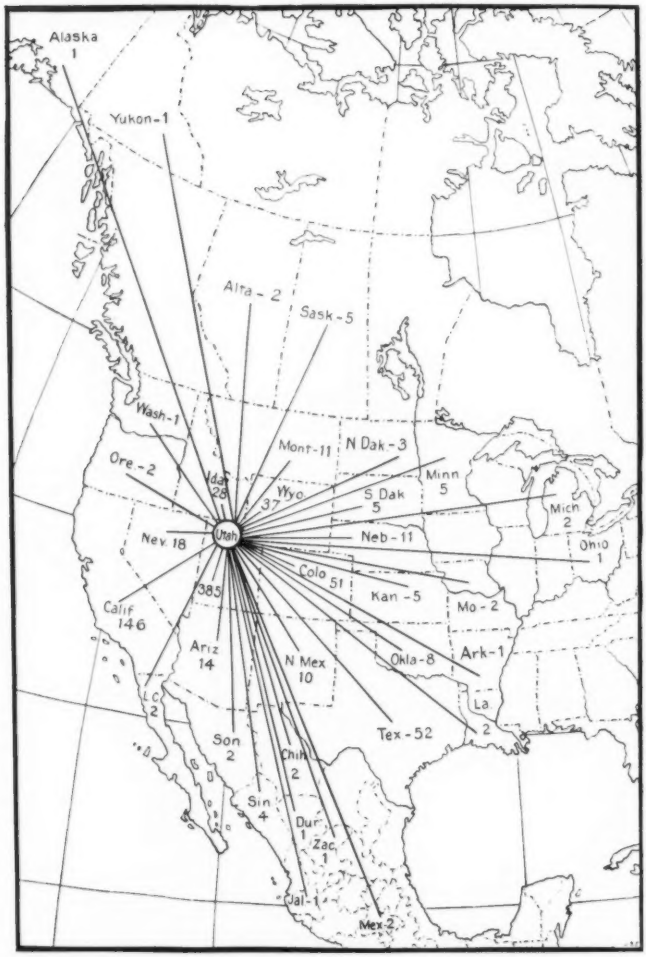

Figure 5. Distribution of Returns from Ducks Banded in Utah.

down some of the Plains States to the Gulf Coast, it appears that many ducks from this area actually leave in a northeasterly direction. This is particularly true of a part of the Redheads, 36 of which were recovered in Wyoming, 9 in Montana, 4 in South Dakota, 3 in North Dakota, 5 in Minnesota, 2 in Michigan, and 1 in Ohio. Some of these birds were killed within two or three months after they were banded in midsummer and appear to furnish definite proof that many Redheads from the Bear River region have a northeasterly flight line that connects with the route of this species coming down out of the Prairie Provinces of Canada in a southeasterly direction by way of the Great Lakes, and which has its southeastern terminal on the Atlantic Coast, chiefly south of Delaware Bay. Actually, however, no Bear River Redheads have as yet been recovered on the Atlantic Coast but it would seem that such records may be confidently anticipated.

Another feature illustrating the value of these marshes is the large number of return records from California which indicate this to be the most important wintering grounds for the ducks from Utah, a fact that has much significance for California sportsmen.

The record from Yukon Territory is for a Green-winged Teal, the one from Alaska is for a Pintail, while the 15 from Mexico are for 4 Pintails, 2 Cinnamon Teal, 1 Green-winged Teal, and 8 Redheads.

WISCONSIN

Waterfowl banding in Wisconsin was started in 1928, when Frank Hopkins opened a station at the Moon Lake Wild Life Refuge, near Campbellsport, and Frank A. Schader (operating under the direction of L. H. Barkhausen, of Chicago, Ill.) started a station at Big Suamico, on Green Bay. The operations of these stations have been continued each season and as a result 4,135 ducks have been banded. The division by species is: Mallard, 2,795; Black Duck, 695; Wood Duck, 170; Pintail, 40; Bluewinged Teal, 38; Green-winged Teal, 17; Ruddy Duck, 9; Lesser Scaup, 7; Shoveller, 4; Greater Scaup, 3; Hooded Merganser, 3; Widgeon, 2; Gadwall, 2; Ring-neck, 1, and Canada Goose, 50. From this work 706 return records are available for study. The large number of local captures (Fig. 6), together with the relatively small number from the Canadian Provinces seems to indicate important breeding grounds in the region of the banding stations. It is probable that this includes not only a large part of the State of Wis-

Figure 6. Distribution of Returns from Ducks Banded in Wisconsin.

consin, but also adjoining parts of Minnesota and the upper peninsula of Michigan.

Two well defined flight lines are indicated by the data at hand. The first is the important Mississippi Valley route and in this case it will be noted that there is a more nearly uniform distribution of the records from the States on both sides of the river. Winter quarters for these birds seem to be chiefly in Arkansas, and the Gulf States.

The other route is to the southeast by way of Michigan and Ohio, thence cross-country to the Atlantic Coast. A few, working along the south shores of Lakes Erie and Ontario, reach western New York, and a few may possibly cross this State to the coasts of New Jersey and Long Island, although as yet the evidence does not warrant full acceptance of this hypothesis.

The record from Prince Edward Island is for a Mallard that was killed two years after banding.

In view of the small number of Ruddy Ducks that are banded, two returns for this species are of unusual interest. Both (Nos. B600420 and B600421) were banded as immatures at Big Suamico, on September 25, 1931. One was killed on Carman's River, Long Island, on November 18, 1931, while the other was recaptured at Raspeburg, Maryland, on December 9, 1931.

THE STATUS OF CAPE COD TERNS IN 1933[1]

By O. L. AUSTIN, Jr.

WHILE the 1933 tern season, viewed from the angle of chicks matured, left much to be desired, it was in many other ways most interesting and profitable. Tern Island produced a large number of young, which offset in part an aggregate of small calamities on the other rookeries. Heavy easterly storms early in July ruined most of the smaller exposed nesting sites just as the eggs were hatching, and created much havoc on the larger ones, but the frustrated birds soon laid second clutches of eggs. As most of our time was given over to trapping adults on the nests, the general distribution and dissemination of the parent birds for their unsuccessful second nesting was observed in considerable detail. The capture and banding of adults garnered much data of great value in our studies of the distribution and general ecology of the species. This, however, is being reserved for a second paper to be published during the coming winter. This article is simply a narration of the season's activities.

THE RECLAMATION OF TERN ISLAND

It is certain that the past four years have witnessed a steady decline in the number of breeding birds occupying what long had been the Cape's best tern rookery—Tern Island at Chatham.[2] Tern rookeries are not stable entities. They fluctuate in population cyclically, as has been noted by several observers. Tern Island reached the peak of its cycle in 1929, when ecological conditions there were at their optimum. Since then a progressively increasing rank growth of beach grass, encouraged by the constant fertilization the island has received for a decade, has encroached on the available territory, rendering the terrain unsuitable for nest-building, and allowing cover for a large number of rats. This Station has endeavored to circumvent the normal workings of nature by restoring the Tern Island colony to the peak of its cycle. Previous investigations had determined that two procedures were of essential importance—first to thin out the densely matted beach grass,

[1] Contribution No. 14 from the Austin Ornithological Research Station.

[2] See Austin, O. L., Jr.: "Further Contributions to the Knowledge of the Cape Cod Sterninæ", *Bird-Banding*, Vol. III, No. 4, October, 1932, pp. 123–139.

second to eliminate the rats, which had found excellent cover beneath the ten-year accumulation of interwoven dead foliage. Accordingly, the island was burned over on December 9, 1932, and left clean to the sand. The moment the old grass had gone, an almost incredible number of rat burrows, now deserted were seen.

As the grass did not start to sprout again until late April, the returning birds found a relatively clean island, with a greater area of suitable nesting territory. Rather than "coming to land" suddenly in a body as is their usual custom, the terns arrived this year in small groups. On May 2d a vanguard of fifty birds hovered high over the island. This nucleus was augmented from day to day until by May 15th there were on the island, going through courtship antics and hollowing out nests in the sand, approximately three thousand pairs of birds, an increase of 30 per cent over the preceding season's population.

The first eggs were laid on May 16th, and the general laying continued until May 23d, whereas the corresponding period in 1932 extended from May 23d to May 31st. The northern half of the island, which in 1932 had been relatively unoccupied owing to the density of the matted grasses, now was dotted plentifully with nests and eggs. The increased number of nests in areas formerly heavily grassed is shown by the count in quadrat 4 (see ibid p. 125). This quadrat, marked out in 1932 in the densest beach grass had then supported 25 nests containing a total of 47 eggs, averaging 1.9 eggs per nest. In 1933, after having been burned over, this same area held 31 nests containing a total of 70 eggs, an average of 2.3 eggs per nest. This year 62 eggs, or 89 per cent, hatched, as against a successful incubation of 32 per cent the previous season.

The partly grassed observation quadrat (Q3) was slightly more heavily grassed than the previous year, owing to the sprouting of new clumps from stolons. It contained 35 nests with 90 eggs, an average of 2.6 eggs per nest, as against 30 nests with 75 eggs, an average of 2.5 for the previous year. This quadrat had 57 eggs, or 76 per cent, of the first laying hatch in 1932. In 1933, 81, or 90 per cent, of the eggs completed incubation, an improvement of 14 per cent.

The other partly grassed quadrat of last year (Q1) became enormously overgrown this year. It contained only 34 nests with a total of 89 eggs, an average of 2.6 per nest, as against 38 nests with 106 eggs, an average of 2.7 in 1932. The decrease is a direct result of the excess grass. It was in the immediate

vicinity of Q1 that most of the egg-destruction by rats occurred this year, so that only 56 of the eggs, or 63 per cent, hatched. Rat-control, however, made this an 11 per cent gain over the 52 per cent survival in 1932.

The open quadrat (Q2) remained as it had been last year aside from a closer approach to its boundaries by bordering grass. It supported 25 nests with 59 eggs, an average of 2.4 eggs per nest, as against 32 nests, 83 eggs, a 2.6 average in 1932. This falling off was expected, since terns usually elect lightly vegetated areas in preference to open sand stretches, and the winter burning had provided extensive areas of more desirable terrain, into which the returning breeding birds scattered. 56, or 95 per cent, of the eggs survived, whereas in 1932 the hatch was 90 per cent.

It could not be expected that after the feast the rats had in 1932 they would fail to return to the rookery this year. The burning of the nearby garbage-dump and the curtailment of food at the fish-houses on the adjacent mainland increased the probability of another rodent invasion. In early May it was certain that not one rat lived on the island. The grass was sparse, the only possible cover being a small pile of dry thatch and seaweed deposited on the center of the island close to Q1 by an unusually high March tide. On May 29th two eggs were missing from Q1, and a search revealed two newly-made rat burrows under the thatch. Each day fresh holes were discovered in various places elsewhere on the island. Red squill in fish and meat baits had proved fruitless in 1932, and the burrows then could not be located well enough to make trapping efficient. Now that the burrows were in plain sight, steel traps were set in all the holes. But the rats were evidently trap-wise. Five days of trapping produced but two of them and the foot of a third, and the damage increased, paralleling the experience of 1932. The situation was serious. The rodents were rapidly getting out of hand, and another wholesale tragedy seemed imminent. As a last resort strychnine carried in a rolled-oats bait was tried. Eight quarts of poisoned oatmeal (prepared according to the Biological Survey formula) were scattered over the island, with heavy doses in the burrows and in the neighborhoods where most of the rat damage was noticed. Though the island was searched carefully daily, not a single dead rat was found; but the damage stopped miraculously, and no further signs of rat work were noticed.

The island was similarly repoisoned at weekly intervals until July 15th, when the last chicks of the first nesting had flown

away and second nestings had begun. By that time the grass had become too long for efficient work. A late visit on July 31st showed the rats again in full possession of the island, living on the eggs of renesting birds. But the rookery had succeeded so well in its yearly duty of replenishing the breeding stock that a failure of the second nesting was of no great moment.

The chicks commenced to hatch on June 7th, five days earlier than the preceding year, and continued hatching until June 20th, with the peak between the 12th and 16th. Food fish had been relatively scarce all spring, and the slender lance for which the terns show a decided preference was not observed at all. The usual schools of "bait" had not appeared in the run between the island and the mainland, and the incubating adults were forced to seek sustenance in the harbor, and even in the open ocean beyond the bars, three miles away. The old birds found enough for themselves, but when the hatching of the chicks demanded a heavy increase of food, the absence of the usual schools of minnows which supported them in former years caused a mortality by starvation of well over 50 per cent of the chicks which hatched previous to June 17. We saw on the island minnows four and five inches long, which were much too large for the young terns to swallow, and a herring six inches in length was found in the center of the colony! Fortunately, on June 17th the "bait struck in" and ended the starvation period. On that day a census of the island showed 634 live chicks and 644 dead ones (two hundred of the dead chicks had been banded on previous visits). The dead chicks were all buried, so that an accurate check might be made on total mortality. With the rats under control, and an adequate food-supply available, the hatch then prospered. In our later work on the island, during the banding of 2137 more chicks, we encountered but 305 dead ones, showing a subsequent mortality of about 12 per cent.

Thus we banded on Tern Island this year 2,458 young Common Terns and 513 young Roseate Terns, a total of 2,971, of which probably 80 per cent matured sufficiently to fly away. Although this is less than half the number of young the colony produced in any one of its good years between 1925 and 1929, it may well be considered as successful in comparison with the total failure of the rookery in 1932.

EGG ISLAND

Egg Island, in Lewis Bay, was the most productive rookery on the Cape in 1932. There were banded on it that year 5,425

chicks. Since the island afforded the best ecological conditions of any of the Cape's nesting sites, such as insular isolation, freedom from predators, and ideal vegetation, its prosperity was expected to continue for several years. Its geographical location, which provided shelter from the most destructive storms, promised to preserve its physical characteristics indefinitely. But allowance had not been made for human interference. During the summer and fall of 1932 dredging operations were carried on for the widening and deepening of Hyannisport Harbor and the channel leading to it through Lewis Bay. This resulted in the establishment of new currents which during the winter eroded away fully one quarter of the northern end of the island, and narrowed the remaining portion markedly. The returning birds found available in 1933 not more than 60 per cent of the space they had used the previous year, when the rookery had been fully occupied. Consequently this year the population was 40 per cent lower than in 1932.

The Egg Island birds, as usual, returned and commenced nesting a little later than did the Tern Island occupants. The chicks began hatching June 11th, but the majority did not emerge from their shells until June 20th. During this period the island was swept by electrical storms, one of which, on June 12th, was accompanied by great numbers of large hailstones. Each of the storms took considerable toll of the newly hatched fledgings, so that of the first hatch, which should have numbered at least 3,000 chicks, there survived for banding only 1,354. Many of the adults that had lost their eggs or chicks during the storms promptly laid again, mid-July showing a second incubation under way extensively all over the island. A few of the frustrated birds had gone to other sites for another attempt at nesting, as our adult trapping showed, but the greater part elected to relay on Egg Island. The eggs of the second nesting commenced hatching on July 31st, but continued rains attended by easterly winds during the following ten days killed almost all the young that emerged. On August 17th we combed the rookery and found but ten half-grown chicks, eight of them Roseates, and two Commons. This proportionately greater survival of Roseate than Common chicks during bad weather, especially hard, cold rains, results from the Roseates' tendency to hide, except when being fed, under protecting clumps of grass.

PAMET RIVER ROOKERY

This rookery has been so markedly unsuccessful during the past several years, owing to its poor insularity, that it was determined to waste on it this season no more time than necessary. On June 13th we estimated an adult population of 350 pairs—a noticeable increase over 1932. Tidal action had extended the northward end of the island about a hundred yards, and there were eighteen nests on the new land. Predator conditions, however, were still as unfavorable as ever. There is abundant cover for rats in the tangle of flotsam and grass, and as the bars between the island and the mainland dry at high tide, four-footed prowlers find a ready means of egress to the colony. The bathing-beach on the mainland at the north end of the island has become increasingly popular, and the birds have very little chance of rearing their young successfully unless they nest so early that the juvenal birds are able to fly by July 1st. Owing to the high percentage of mortality consequent to such conditions, it is not considered worthwhile to band the chicks until they are at least three-quarters grown, when chances of band-wastage are lower. On June 30th we banded 40 such chicks, and on July 12th, when the rookery was almost deserted, two more.

This rookery is noteworthy in that it supports one of the two best colonies of Arctic Terns on the Cape. On June 14th there were eighteen pairs of this species nesting in the sand just above the high-tide line on the westward side of the island. It is extremely doubtful if any of them reared young, for two weeks later the nests were gone, and no chicks could be found.

BILLINGSGATE AND JEREMY'S POINT

Billingsgate is now a high sand-bar, entirely devoid of vegetation. A strip a quarter-mile long and from ten to two hundred yards wide is dry during normal tides, but covers over when the moon is full. It was washed completely over on May 13th, and again on June 10th. Shortly after this, however, the terns started breeding there again. On June 27th the we found 250 nests along the crest of the island, all of them of Common Terns.

We trapped 159 of the adults, of which 20 were already banded. Fifteen of the banded birds had been handled first in previous years (ten at Billingsgate, six in 1932 and four in 1929, and five at Tern Island between 1927 and 1932) but five had been captured earlier in the same season incubating eggs

on other rookeries. Of these two were banded on Egg Island, June 2d and June 7th, respectively, and two at Tern Island, May 24th and June 9th, respectively. The last bird was banded June 10, 1932, at Pamet River Rookery and retaken at Tern Island, Chatham, June 12, 1933, and now appeared for its second nesting in 1933 at Billingsgate.

This nesting was unsuccessful, for the island was again inundated on July 6th, and all the eggs washed away. The next inundation was on August 5th, but throughout July and August constant sailing and picnic parties kept the birds away from the sand-spit.

Jeremy's point has shown possibilities of eventually becoming a rookery. Terns have attempted to nest on it many times in the past decade, but have always been routed by scavenging cats, skunks and foxes from Great Island, to which it was attached. A storm two winters ago broke the base of the point through, making an island of it at high tide, and subsequent gales this past winter deepened the cut-through, so that the point is connected to Great Island only at dead low water. But this spring, for the first time in at least four seasons, the terns made no attempt whatsoever to nest on the Point. Why they did not defies explanation, for ecological conditions seem quite suitable.

HOPKINS AND ROCKY ISLANDS, AND NAUSET POINT AND MARSH

Hopkins Island is rapidly approaching the low part of its cycle. The rookery is becoming so heavily overgrown with wild rose vines and beach plum bushes that the terns are in danger of being crowded off. The tangle makes it almost impossible to find the young, once they have left the nest, and, of course, affords excellent shelter for the omnipresent rat. Negotiations, as yet unsuccessful, have been attempted to secure title to the island in order to restore it by removing the vegetation.

Terns were observed flying about Hopkins Island on May 11th, and by June 1st there were 197 nests being incubated—an increase of two over 1932. On June 28th a careful search revealed only three fairly well grown chicks, and 37 nests, in two of which were newly hatched young. The island was honeycombed with burrows of field mice (*Microtus*), which have never been known to damage the tern nests. Under a large boulder on the north side of the island was a burrow in

which a number of broken eggs were found, which points to probable rat invasion.

Rocky Island remained unchanged from 1932. Thirty-five nests were built there in June, the same number as in 1932, and but few, if any, chicks were reared to maturity. The island is too small to allow them any cover, and every storm-driven tide covers it. It was inundated during the easterly gale of July 3rd and 4th.

The Nauset Marsh colony continued to expand. On May 18th we observed two hundred birds playing over it. On the next visit, June 20th, the birds had increased, and while trapping 97 adults we estimated 250 nests. The rookery was bothered late in June by summer visitors from Nauset Heights, and the early July gales finished it.

At the base of the outermost dunes on the tip of Nauset Point a splendid colony of Arctic and Common Terns established itself late in May. There were slightly over one hundred nests, of which thirty were of Arctics. On June 21st we trapped 48 of the Common Terns and 18 Arctic Terns, of which one was a bird banded as an adult on near-by Hopkins Island in June, 1929. Three of the Common Terns were returns, one banded as an adult in the Nauset Marsh colony in 1932, the other two both banded on Tern Island in 1929, one as an adult, the other as a juvenal. The Point Colony was wiped out entirely by the easterly gale of July 4th, which deposited almost two feet of sand on the rookery site. The birds attempted nesting again in the dunes a quarter of a mile to the northward, where they were soon broken up by marauding animals.

North Beach and Monomoy Point, Chatham

It will be remembered that in 1932 many of the terns which had been driven from Tern Island by rats attempted their second nesting at the tip of North Beach, across the mouth of Chatham Harbor. The sands of this point shift continually from the action of wind and tide. This year an additional hook made out at the southern tip of the point. A handful of terns made forty nests in the neighborhood of their old site, but were disrupted by the usual agencies in June. Twenty more pairs attempted to nest in July on the new hook, but these were likewise a failure.

Experience shows that very seldom are any of the beach colonies successful in raising broods to maturity. We were able this year to investigate the reputed Monomoy colonies,

which proved not only to be unsuccessful, but likewise never to have been so large and prosperous as reported. Small isolated colonies established themselves on the outer beach between the old lighthouse and the tip, but they were all broken up, almost before they began. Monomoy abounds in skunks, and there are many dogs and cats kept by the Coast Guard.

SUMMARY

As an index to the status of the terns on the various rookeries, the following summary of the numbers banded in each of the colonies is appended:

TERNS BANDED IN 1931, 1932 and 1933

	ADULTS									CHICKS								
	hirundo			*dougalli*			*paradisæa*			*hirundo*			*dougalli*			*paradisæa*		
	'31	'32	'33	'31	'32	'33	'31	'32	'33	'31	'32	'33	'31	'32	'33	'31	'32	33
Tern Island	77	704	892	2	1	5	..	2	5	5085	1716	2458	1045	38	513	..	..	..
Egg Island	..	53	1458	..	1	8	..	..	..	1721	4220	1134	55	1205	218	..	..	..
Billingsgate	..	52	159	..	..	..	..	..	..	418	118	..	..	..	..	..	..	..
Pamet River	31	9	108	..	..	..	4	3	11	125	5	42	..	..	..	..	..	..
Hopkins Island	9	1	..	..	..	..	..	..	..	122	161	3	..	..	..	..	2	..
Rocky Island	..	..	..	..	..	..	..	..	..	40	4	..	..	..	..	..	..	..
Nauset Marsh (Inlet)	..	126	109	..	..	..	..	..	..	41	108	..	..	..	..	..	..	..
Nauset Point	..	..	51	..	..	..	..	1	19	..	..	..	..	..	..	..	..	5
North Beach	..	286	..	..	..	..	..	..	..	..	225	..	..	..	..	..	1	..
Totals	117	1231	2777	2	2	13	4	6	35	7552	6557	3637	1100	1243	731	..	3	5

	Adults	*Chicks*	*Total*	*Returns*
1931	123	8652	8725	1931 18
1932	1239	7803	9042	1932 62
1933	2825	4373	7198	1933 234
	4187	20,828	24,965	314

North Eastham, Cape Cod, Mass.

GENERAL NOTES

Eastern Bluebirds in Juvenal Plumage Feed Young of Second Brood.—On June 4, 1933, the first brood of four young Bluebirds of C160154, male, and B176467, female, left the nest. Later in the month the adults built again in a nesting-box about two hundred feet distant from their first nest. The young Bluebirds of the first brood remained with their parents constantly during this time, usually perching on cross-pieces nailed to the post on which the nesting-box was placed. So far as is known, the adults did not feed these young after the second nest was built, nor did they seem to resent having the young birds perch about on the house and even on the step at the entrance. On July 22d an immature female Bluebird was seen entering the nesting-box with a grasshopper. The bird was captured and banded with a green band for further study. The following day an immature male entered the box with food and was also taken and banded with a black band. These birds both proved to be young of the first brood. At the same time it was noticed that a green-banded male, C160177, was also carrying food to the young. The parent Bluebirds both wore blue bands. This additional male had raised a first brood about five hundred feet from the present nest of C160154, male, and B176467, female, but his mate, B176225 female, had taken another male, C160301, for her second nesting, leaving him without a mate. The feeding territories of the green- and blue-banded males had overlapped, each having a favorite perch on the same telephone-wire, but as the green-banded male was not seen around the nest until the eggs hatched, it is believed that the blue-banded male was the real parent of the young.

These two males, the female and two immature birds, continued to feed the young in perfect harmony, and on July 27th, two days before the young left, the nest was watched for two hours during the afternoon to determine how frequently each fed the young. The results follow:

Time	*Color of Band*	*Sex*	
2.50	Green	Male	Entered, fed two insects, removed fæcal sac
2.51	Green	Female	Fed from perch
2.53	Blue	Female	Entered, fed insect
2.53½	Green	Female	Entered, fed insect, removed fæcal sac
2.54	Blue	Female	Entered, fed insect
2.55	Blue	Female	Entered, fed insect, removed grasshopper
2.57½	Green	Male	Entered, fed insect
3.00	Blue	Female	Fed from entrance
3.01	Black	Male	Entered, fed
3.01½	Green	Female	Fed young a moth from entrance
3.03	Blue	Femle	Fed insect from entrance
3.05	Black	Male	Fed insect from entrance
3.06	Blue	Male	Ate the insect (after trying to feed it to the young from entrance)
3.07	Blue	Female	Fed insect from entrance
3.11	Blue	Female	Entered, fed insect
3.28	Blue	Female	Entered, fed insect, removed fæcal sac
3.29	Green	Female	Entered, fed insect, removed straw
3.31½	Green	Female	Entered, fed insect, removed fæcal sac
3.36	Green	Female	Fed berry from entrance
3.39½	Black	Male	Fed insect from entrance
3.40	Blue	Male	Fed insect from entrance
3.44	Green	Female	Entered, fed insect, remained one minute
3.46	Black	Male	Fed from entrance (a piece of grass and probably small insect)
3.50	Blue	Male	Fed insect from entrance
3.53	Green	Male	Entered, fed berry, removed fæcal sac
3.55	Blue	Female	Entered, fed insect
4.05	Green	Male	Entered, fed insect, removed fæcal sac
4.06	Blue	Male	Entered, fed grasshopper, removed fæcal sac

4.19	Blue	Male	Tried several times to enter, then ate insect
4.20	Green	Female	Entered, fed insect, removed fæcal sac
4.21	Blue	Female	Entered, fed insect
4.23	Green	Female	Entered, fed insect, remained one minute
4.23¾	Blue	Female	Fed insect from entrance while green female was inside
4.24	Blue	Male	Fed katydid from entrance while green female was inside
4.31	Blue	Male	Entered, fed worm, removed fæcal sac
4.32	Green	Male	Fed berry from entrance
4.34	Black	Male	Fed insect from entrance

Thus during the two hours the adult green-banded male fed 5 times, the adult blue-banded male fed 8 times, the adult blue-banded female fed 11 times, the immature green-banded female fed 9 times, and the immature black-banded male fed 4 times.

All cleaned the nest except the young male. The blue-banded male, who was evidently father of the brood, displayed more fear than the others. He had difficulty in entering the box and at least once ate the food after trying several times to give it to the young. When both males arrived at the nest with food at the same time, one greeted the other with characteristic Bluebird fluttering and caroling, similar to that of a mated pair, but the green-banded male always fed first, probably because he was more fearless. The immature female when feeding lingered in the box and cleaned the nest more often than even the adult female. That the adult male Bluebird left unmated should assist in feeding the young seems not so strange as the fact that two young of the first brood should feed and care for their younger brothers and sisters when they themselves were only two months old[1].—Mrs. Kenneth B. Wetherbee, Wetherbee Pastures, Pomfret, Connecticut.

Further Notes from Penikese Island Terns.—During the summer of 1932 many tern colonies along the Massachusetts Coast suffered more severely than during any year so far recorded. The details of these bird tragedies have been exhaustively described by Oliver L. Austin, M.D., and Dr. Oliver L. Austin, Jr. (see *Bird-Banding*, Vol. III, No. 4, pp. 123–139 and pp. 143–156.)

In the case of Penikese Island, the terns returned to their nesting colony in the usual numbers in the spring of 1932, and breeding proceeded normally until the season was well advanced. Eggs and young were produced in abundance, and a successful rearing appeared to be in the making, when suddenly the adults completely deserted the colony, and eggs, young, and adults vanished almost over night. (See *Bird-Banding*, Volume III, No. 4, pages 173 and 174.) The reason for this strange disappearance has not been determined. It was, therefore, with great interest that Penikese Island, lying near the entrance to Buzzard's Bay, was again visited from July 1st to July 5th, 1933, by the same group of banders that were on the island the previous year during the correspondening period. As I have previously stated, the island is completely covered to the water's edge with long thick grass, in which the terns nest under conditions quite in contrast to those in other Massachusetts colonies, where open sandy tracts on islands

[1] This exhibition of one of the series of procreative instincts out of the usual order, which begins with the sexual urge, followed by mating and nest-building, and ends with the discontinuance of feeding the young, is of great interest as none of the antecedent instincts in the series, generally regarded as essential to the appearance of a successor, could well have been manifested.—Editor.

or mainland are preferred. Warden Turner reported the appearance of the Penikese terns on the average date of arrival, and a survey of the island revealed their presence in thousands. The Common Terns, as usual, greatly outnumbered the Roseates, the old breeding-areas being occupied. These areas can easily be determined by the dead and matted vegetation, and the sparse new growth of the year. All over the island nests with eggs were found in new locations, and the young were hiding in the long grass in great numbers. The adults were obtaining food with a minimum of effort, constantly fishing with success around the island and catching small fish in such abundance that there was no fighting among them. The hatch and growth of the chicks was excellent. There were almost no dead birds, and the living were fat and healthy, despite days of fog, rain, and cold.

In many of the Massachusetts colonies where the nests are all built on sand with little beach grass, the nests and young are crowded together so that when the young wander from their home into territory claimed by others, they are often so severely pecked about the head while being driven away that they die. On Penikese Island there is no crowding of nests, and consequently no mortality from this cause. The first hatching of young birds was well advanced, and all the chicks were about of uniform size, with very few just out of the eggs. This uniformity indicated that the first clutches were laid at approximately the same time and that there was a marked interval between this and the second laying of the hundreds of eggs that the adults incubated.

In the report of last year's observations (*ibid* page 173) comment was made upon the large number of garter snakes that were introduced in to the island years ago in the days of the Agassiz School and that swarmed all over the island, undoubtedly devouring an undetermined number of eggs and young. Much to our surprise, this year we found that the snake population had been practically exterminated by Herring Gulls that nest in a small colony on the east side of the island. During the spring months of this year the gulls were hard pressed for food and frequented the place where Warden Turner empties his garbage into the ocean, fighting over the scraps, a proceeding not before seen except during a severe winter. When the snakes came out of their seclusion during the warm spring days to bask in the sun, they were attacked and devoured by the gulls, which coursed over the island like Marsh Hawks. On several occasions the Warden observed them catch a snake and carry it to the salt water, into which they doused it several times, shaking it savagely before eating it. In former years, when the Warden has killed and thrown the snakes into the water, the gulls have not been seen to eat them. The Herring Gulls have practically eradicated an introduced form of wild life that in years to come would undoubtedly have threatened the very existence of the tern colony.

Despite a growing sentiment the country over, against the taking of birds' eggs for food or commercial purposes, and the laws passed to prohibit such action, Warden Turner reports that on several occasions this year the island was visited by fishermen of foreign extraction, who but for his vigilance would have destroyed and carried away many eggs and probably have broken up the colony. Their method is to stake off certain areas and destroy all the eggs therein. The robbers then return in a few days to collect and carry away all the new-laid eggs in the marked area, thereby ensuring a new laying. The eggs are removed as long as the birds continue laying, or until the pillagers have satisfied their wants.

The birds banded are as follows:

Adult Common Terns	34
Immature Common Terns	1966
Immature Roseate Terns	300
Total	2300

—CHARLES B. FLOYD,
Auburndale, Massachusetts.

Banding Some Birds of Prey.—In the two years since I got my banding-license and commenced banding whenever opportunity offered, without trapping, I have banded fourteen birds of prey and had two returns. On June 9, 1932, I climbed to a Red-shouldered Hawk's nest that I had long known and found two young still downy but for pin-feathers on their wings. One merely opened his mouth wide and stuck out his queer-shaped tongue at me; the other backed to the verge of the nest, stood upright with little wings wide-spread, and shrieked. His call had the typical downward inflection of his kind. The parent answered, swooping down within a yard of me, but then vanished. Neither of these birds (B661484–5) has yet been heard from. Others were raised in 1933 but had already flown when I went to band them.

On June 24, 1932, I was guided by H. C. Holton of Mt. Hermon, Massachusetts, to a Marsh Hawks' nest which he had discovered on May 29th while searching for a Bitterns' nest. It had then contained five eggs, but we found only three young, of different ages. The oldest scrambled off into the bushes, and had to be brought back by the wings and held (very belligerent) until banded, when it again dashed away. The second resisted with quick strokes of claws and bill, but remained on the nest. The third was diminutive and very meek. Three weeks later, July 15th, one of these Harriers was shot in the neighboring town of Bernardston by a twelve-year-old farm-boy. Alarmed at finding a band on the bird, he buried it, and only much later told his father about it. Hearing the story from the father, Mr. L. R. Nelson, taxidermist, of Winchester, New Hampshire, dug up the remains and forwarded the band to Washington. Presently I was notified that B661476 was "reported shot by L. R. Nelson"—an ambiguous sentence that I misinterpreted. I wrote Mr. Nelson (whom I had met) reproaching him with killing, so young, a bird protected in Massachusetts. He indignantly replied with the above account.

On June 28, 1932, I climbed into the church-steeple in Springfield, Massachusetts, where two broods of Barn Owls had been raised the previous year. Two addled eggs and two downy featherless youngsters were found on the dung-crusted masons'-platform. They hissed furiously and backed away. Neither parent appeared. A few days later, an adult Barn Owl entered an eighth-floor window in an office-building and was held captive for several days. Fearful of starvation for the young, I wrote the Springfield papers about them, and the son of the church janitor took them under his protection. On October 21st one of these two was shot "by mistake for a Barred Owl" at Whitman, Massachusetts, eighty-two miles due east of Springfield. "This kind of owl is unknown to me; please send me information," wrote the killer in returning the band to Washington. Long, purposeless flights of this kind probably first brought to Massachusetts the Barn Owls that now seem so firmly established. The nest-mate, B661481, has yet to be heard from. In 1933 Barn Owls bred in the tower of the Court House, unsuccessfully (because so early) in February, but successfully later in the spring, and their unsophisticated children got into many difficulties

in July, entering a photographer's studio, perching where boys could nab them, and even getting picked up by traffic-policemen from the middle of streets. Two that were taken to the Society for Prevention of Cruelty to Animals headquarters were banded by me, C616776–7, before release.

On July 15, 1932, the weak, shrill scream of a Broad-winged Hawk called my attention to a nest fifty feet up in a white pine in rocky, wet woodland in Hadley. With alarmed expressions, three young were found in the nest. I had only one No. 6 band left, and had to put No. 5's on two of them. They offered no resistance to the operation of banding. Their eyes were baby-blue, and their feathers were about half grown. A number of hawk feathers were in the nest, which I supposed had been shed by already molting parents. What was my surprise when at the Harvard Museum they were positively identified as eggs of the Cooper's Hawk! As soon as I could, but two weeks later, I went back, but the nest was empty and I could only hear, and barely glimpse, the hawks in the foliage near by; so I reported the three as Cooper's Hawks. Revisiting the place on June 28, 1933, I several times heard and finally glimpsed a Broad-wing, but the high nest looked unoccupied. July 16th, however, I determined to climb to it again and found in it three cold, rain-stained eggs. These I compared with museum specimens: they were positively the eggs of a Broad-winged Hawk. They matched, moreover, the half-shells I had taken, with the Cooper's feathers, from the nest in 1932. So I feel convinced that bands A538161–2 and B661483 are being worn by Broad-winged Hawks, and I explain the presence of the feathers of the Cooper's Hawk either by the capture of a sick or wounded bird of that species or by supposing that a hungry Cooper's Hawk daringly attacked the young Broad-wings and was despatched and eaten by their parents.

On July 8, 1933, finally, I heard from a swampy woodlot in Westhampton the weak scream of a Red-shouldered Hawk. Upon investigation I discovered a youngster perched on a dead limb only five feet above ground. Cautiously approaching, I was able to grab his tarsi. Laid gently on his back, he gripped my hand with both feet, but did not break the skin. Once banded, he refused to let go, and as I strove to replace him on his perch I happened to feel his breast-bone, which was frightfully sharp, and realized that his tameness and weak grip came from starvation. Either he had been abandoned by his parents before he had learned to feed himself, or—more likely—they had been killed. I tied the bird to the handle-bars of my bicycle and rode with it to the zoölogical building at Smith College. There he was fattened on mice: two dozen little mice at one meal made his crop bulge ridiculously. After a week, July 15th, I took the bird to the nearest woods and released it. It merely hopped around, but its wings seemed normal. Nine or ten hours later, a friend telephoned me to come and see a big hawk being pestered by Robins, and I beheld my protegé, at a goodly height in a tree. Next morning this friend telephoned again that the hawk had screamed and had apparently been answered by another high in the sky, and had flown up to join it. I shall, of course, be particularly interested to hear (if I ever do) of this bird's fate.

Birds of prey make a romantic appeal to many people. We all deplore the undiscriminating slaughter of them by gunners, farmers, and game-breeders. The pole-trap has been particularly assailed. But it has occurred to me that a humane pole-trap ought to be practical and might be used by banders. Why not make a spring trap, not with metal jaws that grip the leg, but with widely looped jaws of wire filled in with light, loose netting? A bird alighting on the pan of such a trap would then be enclosed in this netting. Set up near game-farms, in sanctuaries, or on the routes of hawk migration

with a captive owl for decoy, such traps might harmlessly lead to the banding of quite a few of these interesting and endangered birds.—S. A. Eliot, Jr., Smith College, Northampton, Massachusetts.

Some Notes on the Hairy Woodpecker.—The question has come up as to whether the male or female Downy Woodpecker (*Dryobates pubescens medianus*) selects the nesting-territory. This raises the same question as to the habit of the Hairy Woodpecker (*Dryobates v. villosus*) in this respect. Turning to my notes accumulated since banding was begun at this station, I find two interesting cases, where the female Hairy took the initiative in this act.

The first case has to do with a female which was first noticed at our yard on February 14, 1931, and later trapped and banded as A379710. She thereafter made it a daily habit of coming to feed, either on doughnut or suet, several times a day. The period of her visits extended throughout the following spring and summer, but with longer intervals between visits during the summer and sometimes with an absence of a few days. By August her visits were again daily and continued to be so until November 1st, after which she was not seen and may have migrated with others of the species, passing over at about this time.

On April 15, 1931, a male Hairy was seen about the station with A379710, and they were together more or less thereafter. There was no active mating display, and at no time was a second male seen to contest the male's suit. The female soon selected a spot on the north side of an apple tree trunk three and one half feet from the ground, and began digging a nest-cavity, working at it silently and methodically, mostly during the forenoon but sometimes of an afternoon. This site is forty yards from our yard: and while the male never came to the yard to feed, the female often left work and came directly to my feeding station. The male rarely came near her when she was at work, and when he did so, he alighted on the trees no closer than forty feet away. She usually met him there, and they flew away together. He spent practically all of his time in the woods and his winter territory to the south, and here the two went when together. Close to this apple tree the Hairy selected, stands a tall and large elm stub in which three pairs of Starlings (*Sturnus vulgaris*) were nesting.

Before the Hairy nest-cavity was completed, the bird was inadvertently frightened away. She then went to a partly decayed elm one hundred and fifteen yards to the southeast, where a second cavity was begun situated some twenty-five feet from the ground, which but for a limb too tough to work through might have served for a nest. On May 14th she returned to her apple tree. The following day the birds were seen in the act of copulation; and in due time a set of four eggs was deposited. A pair of the ubiquitous Starlings, desiring to nest again, entered the Hairy's nest May 28th and destroyed the eggs and drove the female away. She then went to an apple tree twenty-five yards to the northwest, and enlarged an old Downy Woodpecker nest-cavity to accommodate her needs. Again the Starlings disturbed her and they finally drove her out and used the site for their own purposes. The result was that the birds were again driven away and they apparently nested in near-by woods, though the nest was not found. The female continued to feed at the yard, and later both adults were seen when carrying food to the woods. The male disappeared soon after nesting was over and was not positively seen again.

During 1932 a pair of Hairy Woodpeckers nested near my station and were frequently seen, but neither bird wore a band and neither came to our yard for food.

The second case has to do with my 1933 experiences. Three adult Hairies were banded, as follows: A393055 (♂), March 26th; A393058 (♀), April 21st; and A393060 (♂), May 11th. A second female was not captured. Of these birds, A393055 and A393058 afterwards mated. On June 15th their three young were banded. The nest was in a poplar tree at the edge of a woodland one hundred and seventy yards from the station. The entrance was fourteen feet from the ground, and the cavity fifteen inches deep. During the time occupied by me in sawing out a section of the tree to gain access to the young, they kept up a continuous calling. The female lingered in the surrounding trees, uttering her distress call and scolding. The male came with a billful of food, but remained in the background. At no time did the adults carry food from the yard to their young, nor did the young follow their parents to the yard.

Regarding the selection of nesting-territory with this pair, the female (A393058), even though banded twenty-six days later than her mate (A393055), was apparently the first to visit the station; she came on March 13th. Prior to that date, during January, February, and early March, she was probably the unbanded female that had been seen about the village. The male was not seen until March 15th, when he came with the female to the suet. Usually the male and female birds feed separately, and the instance just cited was the only time this pair were known to feed together. Later, whenever one came and the other was eating, the arriving bird fed, the other bird leaving. This male Hairy always came from the east woods when visiting the yard and returned in that direction. On the other hand, the female frequented a near-by territory in a southeast to a westerly direction. Rarely the two were seen in a maple sugar wood to the southwest.[1]

On the morning of April 10th the birds were seen in the act of copulation. On the 18th a second male appeared. Throughout that day and until the 21st, when a second female Hairy arrived upon the scene, the two males were almost constantly courting female A393058. However, soon after the second female arrived, A393060 (♂) divided his time about equally between the two females, but was constantly repulsed by the mated male. On May 10th, he had finally mated with the second female. While the second male (A393060) was actively displaying to obtain A393058 as a mate, A393055, while already mated to her, went through a protective display that did not materially differ from the usual mating maneuvers.

The second 1933 pair of Hairies discontinued coming to the yard about May 15th and were not seen again to my knowledge. Only the banded pair were observed from this date on. The selection of nesting-territory by this second pair is unknown.

Thus, of the first 1933 pair the female arrived first on the territory later utilized for nesting and occupied that part of it during the winter. And, like the 1931 male, this male kept to his territory during the period the female was digging a nest-cavity. This pair ceased to feed at our yard, like the 1931 birds, when they had young. Both A393055 and A393058 disappeared when the first migrating Hairies appeared about the first of August, 1933.—Lewis O. Shelley, East Westmoreland, New Hampshire.

[1] I should explain that with this species each sex has a separate territory, that of the male being close to, but separate from, the female's territory. The male occupies his territory exclusively during the winter or prior to the nesting-season. During the breeding-season the two territories are combined but to just what extent I am not certain; the merging of the two is most marked during the period the young need the most food.

Eighteen More Snow Bunting Returns-W.—So far as I know, there are very few bird-banders in North America who have any success in trapping the Snow Bunting (*Plectrophenax nivalis nivalis.*) I am, therefore, giving here my results for the winter of 1932–1933. This note is a continuation of my three other notes on this species, which appeared in *Bird-Banding*, Vol. I, No. 4, 1930, pp. 187 and 188; Vol. II, No. 3, 1931, p. 127; and Vol. III, No. 4, 1932, pp. 175 and 176.

The winter of 1932–33 was the most successful I have had in the five winters that I have been banding Snow Buntings. My first Snow Bunting capture during the winter was on October 30, 1932, the bird coming to my feeding station when natural feeding grounds became partially covered with snow. This date set a new early record of this species at my station, my earliest previous record being December 7, 1932. Although this bird came to my station at an early date, the winter up to the middle of January, 1933, was mostly favorable for natural winter food, as there was not much snowfall and not much cold weather, with the result that few visited the station until January, at which time sixteen were banded. February set a new high record for number banded, with 114, which is more than were banded any previous winter. The number banded in March was a little less than during March, 1932, the record being 61 in March, 1932, and 44 during March, 1933. The whole number banded for the winter (1932–33) was 174, which is over twice as many as were banded during any previous winter.

My returns for the winter of 1932–33 are as follows:

Band-number	*Date banded*	*Returning dates*	
B80250	February 9, 1929	January 31, 1931	
B80250	February 9, 1929	January 24, 1932	Return-2
B80250	February 9, 1929	February 15, 1933	Return-3
B80275	February 28, 1929	January 21, 1931	
B80275	February 28, 1929	February 19, 1933	Return-2
C98288	January 13, 1931	March 16, 1932	
C98288	January 13, 1931	January 25, 1933	Return-2
C98309	January 24, 1931	March 14, 1932	
C98309	January 24, 1931	March 10, 1933	Return-2
C98315	January 31, 1931	March 17, 1932	
C98315	January 31, 1931	February 5, 1933	Return-2
C98317	February 2, 1931	March 13, 1932	
C98317	February 2, 1931	January 30, 1933	Return-2
B160564	February 3, 1932	February 2, 1933	
B160568	February 7, 1932	February 25, 1933	
B160572	February 18, 1932	March 16, 1933	
B160580	March 7, 1932	March 3, 1933	
B160581	March 7, 1932	February 11, 1933	
B160584	March 8, 1932	February 2, 1933	
B160588	March 9, 1932	January 25, 1933	
B160591	March 11, 1932	February 5, 1933	
B160610	March 15, 1932	February 20, 1933	
B163197	March 18, 1932	February 25, 1933	
B163198	March 18, 1932	February 27, 1933	
B163216	April 3, 1932	February 16, 1933	

It may be noted in the above table that all returns which were banded during the winter of 1930–31 and one from 1928–29 are returns-2, and that one of the 1928–29 birds is a return-3; also that there are no returns from birds banded during the winter of 1929–30.—Oscar McKinley Bryens, R.F.D. 1, McMillan, Michigan.
July 22, 1933.

An Eastern Evening Grosbeak Recovery of Interest.—A male Eastern Evening Grosbeak banded at my trapping station, Sault Ste.

Marie, Michigan, February 20, 1932, was shot at Newdale, Manitoba, November 21, 1932. This is my most westerly record to date. Two of my Grosbeaks were taken in northern Minnesota in 1929, one of them at Karlstad in the northwest corner of the State. Newdale is about thirty-five miles north of Brandon, Manitoba, and some two hundred miles northwest of Karlstad.—M. J. MAGEE.

RECENT LITERATURE

Game Management.—By Aldo Leopold, Drawings by Allan Brooks. Charles Scribner's Sons, 597 Fifth Avenue, New York. London. 1933. 8 vo. pp. i–xxi + 1–148. Price $5.00.

That Aldo Leopold is one of the clearest thinkers now studying the intricate problems of general conservation is evident on every page of this volume, which, besides being the most comprehensive and detailed work yet to appear on the subject, is obviously the product of an orderly, analytical, and open mind.

The author's thesis is, in brief, that "game can be restored by the *creative use* of the same tools which have destroyed it—axe, plow, cow, fire and gun." He defines game management as "the art of making land produce sustained annual crops of wild game for recreational use," and then in eighteen crowded chapters shows in detail and from almost every angle how it may be accomplished. While advocating artificial production of game, and the placing of the "art" on a frankly economic basis, he is careful to define sport, and to draw a middle course between the staged "pheasant drive" type of shooting in vogue in Europe and Great Britain, and the "free hunting" enjoyed by our grandfathers, now unfortunately a thing of the past. He marshals his facts from all the natural sciences, from biochemistry and zoölogy down to animal husbandry and agricultural economics, and he presents a lucid, convincing picture.

Throughout the book—Measurement of Game Populations, Game Refuges, Control of Cover, Control of Disease, Game Economics, and Esthetics are a few of the chapter-headings—the author's thorough grounding in modern biological principles is evident. Ecologists and students of geographical distribution will approve wholeheartedly his practical application of many of their tenets. The principles of ecological interrelationships and the laws of territoriality as expressed by recent thinkers form the groundwork on which his whole management plan is based. Though naturalists now take them for granted, ideas such as that there is a definite and measurable limit to the numbers of birds any given territory can support will probably be regarded by most sportsmen as astonishingly new. Another hypothesis which will undoubtedly be thought radical by the old guard predicates the improvement of environmental conditions as of far greater essential importance towards improving shooting than restocking with hand-raised birds.

The author recognizes the fact that game-birds are disappearing, despite legislative efforts in their behalf. He outlines the usual development of conservation methods as follows:

1. Restriction of hunting.
2. Predator-control.
3. Reservation of game lands (as parks, forests, refuges, etc.).
4. Artificial replenishment (restocking and game-farming).
5. Environmental controls (control of food, cover, special factors, and disease).

He shows how the first two methods, now widely in use alone, have failed to check the steady dwindling of the game-supply, and pleads strongly for the adoption of a sensible correlation of all five methods. But while he shows conclusively how his plan will work for upland non-migratory birds, he fails to suggest a similar workable plan to alleviate the far more critical situation in migratory game. The international scope of the natural economy of ducks, geese, and shore-birds, of course, precludes the confining of their life-histories within the limits of a 170-acre Iowa farm.

Bird-banding is recommended as a means of measuring game populations, and as a basis for all investigations where individual identification is necessary. While the scope of the book is such that but little space can be given to the actual technique of banding, the author refers to most of the essential publications where that information may be obtained. Data garnered through banding are used freely, and not a few important points are driven home by unassailable "return" figures.

All controversial questions are discussed with a fine tolerance for both sides of the question. In some of these, such as the chapter on predator-control, Mr. Leopold leans so far on the side of the biologist that he will undoubtedly make himself unpopular in most sporting circles, though he backs his arguments with incontrovertible evidence.

All too frequently technical writing is of faulty construction and boring in style. It is indeed a pleasure to find this so important book couched in very readable English. The reader is never distracted by flaws in the writing, nor tired by having to wade through the persiflage of verbosity and tautology which many writers on scientific subjects believe necessary to establish an atmosphere of learnedness.

The typography of the book is clean and pleasing. The many charts, maps, and graphs, as well as the black-and-white drawings by Major Allan Brooks, add much to the appearance, as well as the clarity and readability, of the volume. Though the birds on one of Major Brooks's full-page plates look more like Burrowing Owls than the Quail they are supposed to be, one of his vignettes, the tail-piece following the chapter on fluctuation and density of game populations, attains illustrative heights. It is a simple line drawing of a snowshoe rabbit sitting at the peak of its cyclic curve.

This book should be a standard reference work for game-management long after most of the titles in its bibliography are outdated and forgotten. The ornithologist will find it particularly valuable, not only as a compendium of useful information in fields somewhat outside his usual scope, but also as a constant stimulus to his imagination. The author's methodical tabulation of all sorts of data, such as cruising-radii, breeding-potentials, and fertility periods, show many surprising gaps in our knowledge which should provoke needed investigations.

The volume seems admirably fitted for use as a textbook. Indeed, the author suggests as a necessary adjunct to the advancement of game-management, that it be taught in universities, as agriculture and forestry are. Many students, myself among them, will regard his recent appointment to the chair of game-management in the University of Wisconsin as of far-reaching importance, if not the greatest impetus conservation has received since the days of William Dutcher.

We cannot but agree with him when he closes his arguments as follows: "Twenty centuries of progress have brought the average citizen a vote, a national anthem, a Ford, a bank-account, and a high opinion of himself, but not the capacity to live in high density without befouling and denuding his environment, nor a conviction that such a capacity, rather than such density, is the true test of whether he is civilized. The practice of game management may be one of the means of developing a culture which will meet this test."—O. L. A., Jr.

Kluijver on the Biology of the Starling.—The starling is a bird very much in the limelight both in Europe and this country, owing to its controversial economic status, its irregular migratory behavior, its phenomenal increase (in England as well as in this country) and finally to Bissonnette's experiments. Nevertheless, until now there has been no thorough study of its nesting behavior. This gap has been filled by an important contribution[1] both to the study of bird behavior and to economic ornithology from the Agricultural University at Wageningen, Holland. The author improved Bussman's terragraph[2] by forcing the birds to use one hole as entrance and another as exit, so that only entrances would be registered: this he did by means of wires hinged in front of the doors—one set that would swing inward, the other outward, on the same principle as trap nests for fowls. This apparatus he calls an "aphisigraph," or "arrival-recorder." He was able to install these changes on the day that the young hatched. The second year all four boxes thus equipped were adopted by Starlings at the beginning of the season, so that the author was able to get records on incubation as well as on feeding of the young.

In February and March the males come to the nest-boxes and sing for ten to thirty minutes, singing much more on sunny days than in cloudy weather. Females sing in the flock in the roosting-places, but never near the boxes. The females come to the boxes in late March or in April: banding showed that it usually takes several weeks before the pairs are definitely formed. The males start to build before the arrival of the females, but most of the building is done by the latter. The nests of the few unpaired males lack the feather lining and also contain many green leaves and flowers. Building continues until the young hatch.

The average date of the first eggs is correlated with the mean temperature of April. A bird hatched June 23, 1930, and banded in the nest returned to the colony and laid her first egg in 1931 on May 6th, and in 1932 on April 27th, the average dates for first eggs of all the birds being April 27, in 1931 and April 28th, in 1932.

During the day male and female share incubation in short shifts, usually not more than twenty minutes long, at most thirty and sometimes as short as five. The aphisigraph gave the following number of entries per day: 82, 77, 74, 72, 77, 67. The eggs are frequently left uncovered from two to ten minutes. The female incubates throughout the night. Although the male sings a great deal during egg-laying, he stops abruptly with the start of incubation. The eggs hatch very regularly in twelve days.

Only the female broods the young. The female usually does the major part of the feeding, in some cases, especially with late broods, the male doing little or nothing. Starlings are exceedingly zealous in feeding their young, as will be seen in the impressive figures in the accompanying table.

[1] H. N. Kluijver. 1933. *Bijdrage tot de Biologie en de Ecologie van den Spreeuw (Sturnus vulgaris vulgaris* L.) *gedurende zijn Voortplantingstijd.* Veenman & Zonen. Wageningen. 145 pp., 3 pl.

[2] See *Bird-Banding*, Vol. IV, 1933, pp. 33-40.

Age in days	*Number of Feedings in One Day* 1930 *Box 47 4 young*	*Box 48 6 young*	1931 *Box 64 6 young*	1932 *Box 63 6 young*	*Average weight of feedings (in mg.)*	*Growth of Young Average of 5 birds in Box 22 (in grams)*
When hatched		118	118	118		6.8
1		156	151	175	144	
2		180	226	246	186	14.8
3	208	227	218	265	256	
4	247	235	283	298	336	30.8
5	251	306	316	303	439	
6	303	306	323		575	50.4
7	345	476	347		510	
8	300	525	355		641	65.0
9	388	430	331			
10	358	448	380		853	66.8
11	240	472	398		717	
12	401	483	432		828	69.4
13	395	485	450		791	
14	358	440	395		955	71.4
15	366	408	335		987	
16	421	366	430		880	69.6
17	378	393	427		805	
18	359		401		929	73.0
19	297		394			
20	187		185			
21	26					

The numbers of feedings per day increase till about the 8th day, when they stay more or less the same, decreasing a little at the end. However, in boxes 47 and 64 some of the young had left at the age of 19 days. The largest number of trips in one day was 525—the highest record the reviewer has ever found for any bird. The total number of feedings amounted to 6,895 at one nest and 7,668 at another. But since one to five objects were brought at each trip, approximately 15,900 pieces of food were brought to one nest in 1930, and some 27,300 to another in 1931. The average number of feedings per nest per hour during one day at three nests with four, six, and six young respectively was: 4–8 A.M. 30.5; 8–11, 26; 11–2, 21.3; 2–5, 17; 5–7, 18.

Another ingenious method of the author consisted in the placing of aluminum collars around the necks of some of the young and collecting the food from their throats for study. 17,933 objects were thus collected, belonging to 313 species, of which 267 species were insects. The average weight of the feedings was determined; beginning with 144 mg. on the first day it rose to 853 mg. on the tenth (see table). The weight of a feeding amounted to about one-eightieth the weight of the young, but in one case where the female did all the feeding some feedings equalled one-eighth the weight of the little bird. During the first few days the young were fed half their weight each day, but later six-sevenths their weight each day.

The feeding range of Colony A, consisting of 17 pairs, in 1930 was about 62 acres of pasture; in 1931, with 28 nests, it was about twice as large. Although Starlings have greatly increased on the station grounds in the past six years in response to the boxes put up for them, the number of other birds has not lessened.

An exhaustive study of the feeding-habits of the Starlings was made, particularly in regard to Tipula larvæ, or "leather-jackets," a cranefly that does much injury to grasslands in Europe. At times this species formed 26 per cent of the food of the young.

It seems a pity that such a valuable study should not be published in German or English; the three-page summary in English at the end of the volume is helpful, but the main body of observations is available only to those who read Dutch.—M. M. Nice.

Traveling with the Birds. A Book on Bird Migration by Rudyard Boulton.—This quarto volume of sixty-three printed pages, twelve colored plates, and twenty-six line drawings has been prepared in the main for young readers, and well indeed does it treat the fascinating subject of bird migration. Adults, too, will not fail to appreciate its freedom from dogmatism and the author's stimulating manner of presenting the subject. Attention is called to the assistance bird-banding has rendered in determining something of the migration of the White-throated Sparrow, and also the importance this method of bird-study will have in the future in learning the details of migration routes generally.

To my mind the artist has come nearer to making his birds appear alive than any predecessor known to me. This ability is perhaps shown at its best in his portrayal of the Bobolink, Cardinal, Slate-colored Junco, Evening Grosbeak, Cliff Swallow, Golden Plover, Blue Jay, Redpoll, Cape May Warbler, and Black-throated Green Warbler. The method of reproduction employed has not been especially happy in all respects, in that the colors are sometimes of too great intensity, and in two cases at least has resulted in giving a wrong coloration, as shown by the bluish upper parts of the Redstart and the greenish sides and flanks of the Junco. The fact that most of his birds are painted approximately of life size, thus permitting a more detailed portrayal of the eye than would be feasible in smaller paintings, may possibly account for the lifelike appearance of the birds.—C. L.W.

Der Vogelzug, Vol. 4, No. 3, July, 1933.—Meise opens this number with a discussion of kinaesthetic memory and distant orientation of birds. He supports Grinnell's statement that no special sense of direction or "sixth sense" has to be invoked to account for birds finding their way during long journeys. His argument is as follows: perceptions of motion during flight may be received by the labyrinth of the inner ear, by muscular sensations, and by the primary sense organs. To these may be added optical images in some, but not in all, cases. These impressions are unconsciously embedded in the memory and combine themselves there into an absolute image of the road passed over, namely, the terminus, the direction, and the distance. The bird is in a position to retrace or to follow backwards these remembrances, but is not slavishly bound to the exact same path. Frequently there occur variations in the external factors and of the bird's bodily condition through unconscious regulation of its motions so that it may reach the same goal by a different path. This removes the assumption of a guiding stimulus emanating from the terminus of the journey, aiding the bird on its way. Meise assumes no special sense for the unconscious registering of the traversed road and for the equally unconscious recognition of previously registered stimuli during the return journey. He claims that the bird has a memory sense for a definite path to a definite place; this "place and path memory" is often hereditary as is shown by the first journeys of young birds.

It seems to the reviewer that Meise has not greatly simplified the whole problem. By assuming a series of unconscious or subconscious activities, he obviates the need of a definite sense of direction by substituting for it a type of activity wholly directed by subconscious impulses. However, he admits that heredity plays a role, as in the case of young birds making their first autumnal journeys alone. What, then is the difference between his use of "unconscious" and "instinct?" There is none. The distinction between instinct and the idea implied by the term "sense of direction" is not very broad but it is significant. However, it puts the problem of orientation beyond the pale of physiological investigation and is therefore

apt to prove more of a hindrance than an aid to deeper understanding. This is, however, no indictment of the reality of the distinction he draws.

Vilks and vonTransehe present a resume of banding work done on Starlings in Lettland.

Ohlendorf raises the question as to the manner in which the departure of young and old White Storks (*Ciconia c. ciconia*) is regulated with regard to time. He finds, from much banding work at Rossitten and collaborating stations, that the majority of young Storks leave in the latter half of August; the old birds from the middle of August to the first days of September.

The time elapsing between the two groups in any given spot is often very decided, but so far there are no data suggestive of any differential effect of external factors on young or old birds. With regard to the possibility of the young birds receiving guidance from the older ones, or not, data are still far from satisfactory.

Drost gives the 13th report of the Helgoland station, covering its varied activities during 1931 and 1932. In these two years 10,970 birds were banded at Helgoland; since the beginning, thirteen years ago, 45,659 birds of 143 species have been banded at Helgoland, while individual collaborators have swelled the total to 344,304 birds in all. The facilities and collections of the station's library, museum, and laboratory all increased during the two years under review.

Shorter notes include observations on the separation of the sexes of the Lark (*Alauda arvensis*) in spring; on the wanderings of the Kingfisher (*Alcedo a. ispida*) and notes on Danish banding work in Greenland.—H. F.

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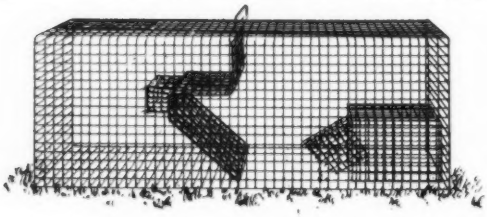

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